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OCTOBER 1953

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SCHOOL SCIENCE AND MATHEMATICS

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THE BIG EVENT OF THE YEAR—NOVEMBER 27-28

"Stimulating Interest in Science and Mathematics" is the theme of the 1953 Annual Convention of the Central Association of Science and Mathematics Teachers. Because of the needs which exist in our present-day society for:

1. An understanding by all its members of the scientific and mathematical principles and concepts with which they daily come in contact;
2. Informed members of society who are interested in sharing scientific and mathematical ideas;
3. Trained personnel to carry forward research in science and mathematics; and,
4. Providing the opportunity for each individual to develop to his capacity and to become a worthy member of our democratic society;

we, as an association, hope to do all we can to assist in the realization of such objectives.

The officers of the sections and groups together with the officers and members of the board of directors of CASMT have worked long and diligently to arrange programs which you will find most profitable, activities in which you will enjoy participating, and exhibits which will assist you in remaining abreast of new accomplishments in the areas of mathematics and science.

The general program of the 1953 CASMT convention has been planned around three objectives: first, increasing information and interest in the most recent research in the scientific areas; second, developing an understanding of the role industry plays in furthering scientific and mathematical research, the practical applications of the research, and the ways in which research affects the lives of each

of us; third, helping educators: teachers, instructors, professors, discover new or different ways through which they can assist those with whom they work arrive at better understandings, draw more accurate generalizations, and come to a fuller realization of the values derived from sharing knowledges and experiences.

Responding to the request expressed by many members of our association, the annual convention this year is being held in a downtown hotel in Chicago. The place of meeting is the Congress Hotel; the dates, November 26–28, 1953. Do you have this on your calendar and in your date book? We shall be looking for you.

This year, for the first time in several years, we are having a CASMT luncheon. This luncheon will be held in the Glass Hat of the Congress Hotel. An excellent program has been arranged for the occasion. It is one of the highlights of the meeting. You will want to attend.

Since the luncheon is to be held at mid-day on Friady, November 27, 1953, it is very urgent that as many reservations as possible be made prior to the opening of the convention. Therefore we urge you to send in your reservation today. All you need to do is to complete the form at the bottom of this page and send it to Ray C. Soliday. Do it now. We want you to join us. We shall be looking for you.

CASMT LUNCHEON MEETING—FRIDAY, NOVEMBER 27, 1953

Dr. Gustav Egloff of the Universal Oil Products Company will speak on the topic: "The Impact of Industry on Science." Make your reservation by completing the form below.

Please reserve _____ tickets for luncheon @ $3.25 each.

Enclosed find check or money order for $_____.

I prefer: Fish _____ Meat _____

Signed _____ Date _____

Address _____

_____

Send reservation to Mr. Ray C. Soliday, Treasurer and Business Manager, Box 408, Oak Park, Illinois.

"Safety lock" for automobile doors may prevent tragedies by keeping the door closed even if children riding inside should accidentally unlatch it. The chrome-plated device clamps to the rain gutter and is locked from the outside with a "twist of the wrist," the manufacturer states.

THE TEACHER'S CREED*

IRVING WILLIAM KNOBLOCH
Michigan State College, East Lansing, Michigan

The struggle for power on this old globe seems to be increasing at an alarming rate. Each nation attempts to present a formidable front to its potential foes meanwhile taking steps to safeguard its rear. These steps take extreme and fatal form in some countries while in the United States they sometimes emerge as attempts to insure loyalty by means of loyalty oaths. These attempts are sure to increase in intensity and number as the pressure increases and are directed particularly at the teacher. The reason for this is clear, for the teacher, at all levels, molds the thinking of the school population and frequently of the adult population.

There is a popular belief that taking an oath will insure loyalty, not just the ordinary oath to the constitution but special oaths. The loyalty of intelligent people is never really insured, however, by oaths but by an abiding conviction in the truth of a cause. Loyalty oaths, among other things, tend to silence minorities and enforce conformity, odious things in a free society. It should be trite to say that loyalty oaths are also un-American. They are also supposed to uncover communists and protect the citizens but, as Professor R. E. Fitch has pointed out, they have a special talent for not doing what they set out to do and for doing what they want to avoid doing. They do not expose real communists because a real communist has no compunction about signing an oath. On the other hand, they can and have injured loyal American who will refuse to sign such an oath on the basis of their principles.

A university which sets a limit upon freedom is not really a university (and the same truism holds for all types of schools). A teacher, as Alexander Meiklejohn rightly insists, ceases to be a teacher and becomes a hired hand if he submits under pressure to control over his thoughts, speech or writing.

To insist that loyalty oaths are unnecessary and do not fulfill their declared function is a negative approach unless one restates what a teacher *should* believe in. It seems highly desirable at this chaotic stage in history to reaffirm our faith in what we are attempting to accomplish. It would be impossible, of course, to devise a teacher's creed which would encompass everyone's idea of what their duty should be but there are surely certain cardinal principles upon which most teachers would agree. Some of these follow. The only originality

* Contribution No. 56 from the Department of Natural Science, Michigan State College.

which can be claimed for the statements in this creed is the choice of words.

I shall try to impress upon all the brotherhood of man, the oneness of the world and the necessity for interest in the good of all mankind.

It is my belief that the modern world has been built upon and is maintained by faith and trust and that there is a vital place in the minds of men for a faith in a Supreme Being.

I shall attempt to instill in my pupils a deep love of our country—a love free from boasting and free to challenge and criticize whenever the need arises.

Since I work in a community, it is my duty to try to understand my community and serve it, as a teacher, to the best of my ability.

I shall try to teach my students to think clearly and logically to recognize true cause and effect relationships and to substitute reason for less reliable guides.

In my own way, I shall instill in those committed to my care a love of knowledge for its own sake.

Realizing my role in character building, I shall do my utmost to develop reliability, self-reliance, neatness, obedience, honesty, politeness, good temper, thrift, carefulness, self-control, kindness, and helpfulness at home, in my pupils.

Most of above statements are self-explanatory but a word about each may obviate any misunderstandings. Few need to be reminded that isolationism and provincialism are becoming more and more impossible as the world draws closer and closer together. All human beings have the same heredity, broadly speaking, whatever beliefs one holds as to the origin of man.

Faith was at one time thought to be a virtue confined to those outside the realm of science but as man continues to delve deeper and deeper into the mysteries of nature he finds more and more order; larger and more unexplainable mysteries. Science does not lead to truth but only to an approximation of the truth. Scientists themselves live by faith and trust in their fellow workers. Public support of the schools is itself an act of faith in the worthwhileness of education. Thus, there seems to be no end of faith—in fact, it must of necessity grow stronger and stronger.

China, Egypt, India, Greece and Italy had civilizations at one time immensely superior to others. Let us remember that! Excessive nationalism may lead to hatreds. In this connection, tolerance is not a substitute for comradeship because no group enjoys being merely tolerated. Our pupils should love their country but be imbued at all times with a measured desire to create an even better society.

The teacher owes his or her sustenance to the community and in return should render competent service. The community should realize that a teacher is in a peculiar position in that he is first and foremost the servant of truth and knowledge. He is to teach the community and therefore the community should not expect him or her to conform because they don't like anyone who is different. Nor should they expect them to alter the truth or to engage in petty politics.

Knowledge in all fields is accumulating at a rather frightening rate. It becomes more and more difficult to pick and choose the really important facts from the unimportant ones. We must teach something, of course, but it is increasingly imperative that we teach students to think, to solve problems, and to wrestle with ideas. Pupils who become mere encyclopedians are frequently at a disadvantage when pitted against those who can reason well. A democracy, in which people govern themselves, is only possible when the people are capable of governing. This means that they must think clearly on issues and they must elect their representatives with a minimum of emotional hysteria.

I think most teachers would agree that subjects should not be taught as a chore which must be gotten over with but as a living experience. Most, if not all, subjects could stand more vitalizing so that pupils come to love learning. Curiosity, a powerful instinct in early childhood, should be nurtured as one would a rare plant. It seems a pity that there are so many more indifferent adults than curious ones.

And lastly we come to the character-building attributes. The list above is that used by the Knighthood of Youth group. Little more of value can be added to it. Biologists describe man as a high type of animal. This, if true, would explain, according to Sir Arthur Keith, his power to hate, to demand an eye for an eye,—his ruthless, merciless, cruel passions—his ambitions, his hunger for priority, for place, for rank, for power, for profit, for praise. Man is competitive, aggressive, pugnacious, covetous, envious and self-seeking. He finds faults with his rivals. He has vanity, snobbishness, egoism, intolerance, fanaticism and vigorous lusts of the flesh. He is predisposed to accommodate his conscience to his desires. These are the things which the average teacher has to wrestle with in this tremendous task of making decent human beings out of animals (or animal-like humans). Along with these assignments, the teacher must try to combat the growing materialism of the age by showing that there are more important things than money or power. These, of course, do not insure happiness. Prestige is soon forgotten. It seems to be true that those who are kind and helpful are remembered the longest.

FREE AND INEXPENSIVE TEACHING MATERIALS FOR SCIENCE EDUCATION

A Supplement to the *Chicago Schools Journal* has been prepared primarily for the use of Chicago elementary and high school teachers, but should prove useful to many others also. In anticipation of the usual heavy demand for our Supplements, extra copies were published so that others might profit from this research. They are available at the cost of handling—ten cents for individual copies, *cost of postage only in quantities of twenty-five or more.*

Write to Muriel Beuschlein, Chicago Teachers College, 6800 Stewart Avenue, Chicago 21 Ill.

A SCIENTIST AND ENGINEER SHORTAGE? WHAT CAN WE DO ABOUT IT?

ROBERT D. MACCURDY AND SHARON MUMFORD
The Senior High School, Watertown 72, Massachusetts

To meet the great demand for scientists and engineers is one of the most intense problems of today, the atomic era. What will become of those students who possess the aptitude, capabilities and drive to work toward that intriguing road of success? Can we develop the interest of students in conferences concerning various fields of science and engineering? Stimulating questions pertaining to this problem are exceedingly numerous and recently something was introduced in effecting a response. The Boston Business-Industry Section of the National Science Teachers Association presented a panel discussion held at the Beaconsfield Hotel involving this very problem, "What To Do About the Shortage of Scientists and Engineers in New England?" Members of the panel were Mr. Wayne E. Keith, General Employment and Training Supervisor of New England Telephone Company, Professor B. Alden Thresher, Director of Admissions at Massachusett Institute of Technology, Dr. Andrew Kasper, Research Scientist of Ionics Incorporated, Mr. Elbert C. Weaver, Teacher of Science at Phillips Andover Academy, Dr. John G. Read, Professor of Education at Boston University, and Dr. Winston Gottschalk, Staff Member of the Research Division, Raytheon Manufacturing Company; the moderator was Mr. Robert D. MacCurdy, biology teacher at Watertown, the Senior High School.

Each participant was given five to ten minutes to speak on his reaction to the shortage of scientists and engineers as it pertains to his own field. Mr. Keith listed many factors that contribute to our present shortage of scientists. These are:

1. Our industrial plant has grown to tremendous size and complexity.
2. The areas where specialized knowledge is required have markedly increased.
3. The number of men in colleges is at a low point because of the smaller number of children born during the depression years.
4. The percentage of scientists and engineering students in our colleges and high schools has decreased.

One thing that we can do and have to do is to reduce the demands for engineers. We may have been wasting the talents of some of them by using them on non-engineering assignments. We can make use of graduates of liberal arts and business administration courses and make sure that engineers and scientists are used to their fullest capacity.

Dr. Gottschalk is convinced that the scientist and engineers situation is critical and sees no easy or quick solution. He indicated that:

1. In the past America has depended on Germany for its pure scientists.
2. America has produced many applied scientists in the past.
3. There will continue to be a great need for people of science.
4. Our periodicals are full of "help wanted" advertisements.
5. There has been a migration westward of our technical people.
6. We need one hundred percent more scientists and engineers than we have now; we need eight hundred thousand scientists and engineers; we have about four hundred thousand in process.

It is a long range problem going back into the schools. Let us look there. Some solutions might be found in the following measures:

1. Expose the nonsense that scientists and engineers are not good citizens.
2. Scale down our engineering requirements.
3. Use fewer trained personnel for routine work.
4. Do more "on-the-job" training.
5. Send our better boys back to school on scholarships.
6. Raise industrial scholarship funds.
7. Carry the message of our need to undergraduates.
8. Carry the message to the high schools.

Dr. Kasper is convinced that our need is imperative. He pointed out the following factors:

1. Russia has more than doubled her output of scientists and engineers and threatens our lead.
2. Taxes are taking much of the funds that we could invest in "Future Americans."

He suggested that some progress could be made if we did some of the following things:

1. "Open-air" tax provisions to allow more funds for research and educational expenditures.
2. Release our industrial employees for "part time" training in our colleges and universities.
3. Take part in a program of training in industry on a part time basis for promising high school students.
4. Participate in school programs designed to help this shortage.
5. Stimulate more original, project, experimental research work in high schools and colleges. Our education has begun to get "soft."

Professor B. Alden Thresher indicated that in his opinion the problem is not only critical, but will become worse. He indicated that there may be more scientists and engineers if we:

1. Increase the "visits to high schools" by our college faculty.
2. Increase the "visits to colleges" by our industrial people.
3. Broaden the admission bases to colleges, use a weighing rather than a screening basis.
4. Increase the study of science in public schools at all levels.
5. Make more efforts to encourage and select more potential scientists among our high school students.
6. Educate our guidance personnel about our needs and urge them not to direct our bright students solely into a liberal arts or business training.
7. Find more ways to identify potential scientists.
8. Find ways to stimulate scientists to become teachers of our future scientists in our secondary schools.

Mr. Elbert C. Weaver stated that some potential scientists and engineers in the secondary schools now are frightened away from a career in science and engineering or simply not attracted to it. He recommended the following changes:

1. Reduce the excessively harsh "death rate" in science and engineering schools.
2. Make the program of training scientists attractive, hopeful, possible, and by all means "fun."
3. Science education is very expensive. To some administrators it seems almost too much for our school budgets. Industry can help bear the cost of supplementary materials and improve the product if it will:
   a. Offer more stimuli to students in science.
   b. Offer more prizes, awards, scholarships, and recognition.
   c. Offer better guidance information and stimulus to guidance directors and counselors.

Dr. John G. Read indicated that our regular and conventional methods have now proved to be inadequate. He recommended that we now consider strongly the following measures:

1. Improve the status of our science teachers. We can't get them without increased pay and other stimuli.
2. Encourage rather than drive our science students.
3. Find better means of screening for science talent.
4. Encourage some industry experience for our teachers.
5. Supply teaching experience for our industry needs.
6. Look to our guidance programs and personnel. Much improvement can be affected there.
7. Industry should make contact with teachers and students directly.

The sources of scientists and engineers remaining among our school children are our economically poor but able youngsters. We must find them and help them. What about an apprenticeship system? A system controlled by schools, sponsored and financed by industry based on competition and references, might solve the problem.

Apparently one of the chief obstacles to the shortage of scientists and engineers is the lack of enthusiasm among the students because they know so little about the subject and its related fields. Suggestions were presented of raising group industrial scholarships and "student placement" in industrial jobs part time. Students could then not only earn money for college but also attain knowledge about industry from the inside. These could be the principal methods to develop interest, knowledge and financial capacity.

The program closed with the speakers and audience involved in after hours personal discussion. It was agreed that all wanted further programs on this problem and needed to consider such factors as politics, labor organizations, public mores, national mobilization, and educational philosophy as they affect the present and future shortage of scientists and engineers.

PLASTICS IN THE SCIENCE EDUCATION PROGRAM

HAROLD HAINFELD
Roosevelt School, Union City, N. J.

Post-war developments in plastics have been of interest to industry, homes and schools. Of particular value as an aid in science education has been the development of transparent plastics as a teaching aid. The use of transparent plastics enables the teacher, for example, to show complex inner parts of machinery. Biological specimens, embedded in liquid plastic that hardens when heated slightly, can be studied without the disagreeable odors of preservatives or the usual disintegration from constant use.

The author was first introduced to the possibilities of transparent plastics while serving as a Chemical Warfare officer and instructor in tank flame-thrower equipment at the Armored School, Fort Knox, Kentucky. Here one type, called thermoplastic (Plexiglas or Lucite) was used to demonstrate the working parts of such equipment as flame-thrower guns, truck, tank and jeep engines and small arms and machine guns. These models all had some working metal parts in them. The plastic material replaced the outer metal covering and thus revealed what the instructor wanted the students to see in operation.

Some of these models offer possibilities on the secondary school level. In the science program, the 4-stroke cycle and the internal combustion engine are taught as part of many high school physics courses of study. Many high school industrial arts shops are equipped to make these aids.

The transparent plastic used is familiar to many. When heated to a temperature of approximately 250°F., the material becomes soft and pliable. When cool, it will retain the molded shape. This plastic can be cut, filed, sanded, turned and polished to give the desired transparent effect. Most school shops are equipped with lathes and other tools necessary to make these valuable science teaching aids. Additional information can be obtained from DuPont, Wilmington, Delaware.

The use of thermosetting plastics (Castolite or Ward's Bio-Plastic) offers even greater possibilities for the science teacher. This clear liquid plastic, when heated slightly, hardens into a clear solid block. Its use as a project is excellent for the teacher with limited equipment and facilities. The process is so simple that upper elementary and junior high school students can easily make these mounts for the science room. By adding a few drops of hardening agent, the liquid plastic is poured into a mold and heated to a temperature of 110–115°F., for a period of 20 to 30 minutes. The result is a clear, hard

block of plastic. The object or specimen to be embedded is placed on this block in the mold. Another quantity of the liquid is added and the process repeated until the specimen or object is completely covered. Shrinking slightly on cooling, the mount easily drops out of the mold and is ready to be polished. With this method, it is possible to introduce many specimens at an earlier phase of science education. The disagreeable odor of preservatives and the disintegration of the specimen is eliminated. The project may be made into a projectable aid by showing it on the screen in a darkened room on the opaque projector. Many more students can observe the enlarged specimen in this way.

It is easy to set up the oven for making this type of mount. Use the heat from two 200-watt bulbs for the project. Each year the 8th grade pupils at Roosevelt School embed an object or specimen in plastic as part of their science experiences.

A third type of plastic offers many possibilities for developing science concepts in the lower and intermediate elementary grades. This plastic, (Spantex) hardens when exposed at normal room temperatures. Outline shapes of flower petals and insect wings can be made with brass wire or the wire from the top of milk bottles. The student dips the wire outline into the liquid. When removed, the model is held in the air for about two or three minutes. A clear hardened plastic is formed between the wire outline. With the use of artificial stamens, pistils, cloth tape and paint, it is possible to construct many flower and insect specimens. More information on this project can be obtained from many art and craft suppliers or from Magnus Crafts in New York City.

The use of transparent plastics for objects, models and embedded specimens offers many possibilities for students to help in visualizing their science program. Their use permits the preserving of materials, eliminating the necessity of smelly preservatives and the disintegration of specimens. It enables the student to see and better understand the complex movements of engines and machines. Thus, they make a valuable contribution to the growing technique of a visual science, student-participation methodology.

Three-D movie screen for the classroom or home minimizes the need for darkening the room. Satisfactory for either third-dimension or regular movie projection, the screen offers uniform brilliance and high color fidelity. A roll-up model will be put on the market "as soon as possible."

Magnetic instrument helps doctors remove steel splinters lodged in the eyes of industrial workers. The instrument also has a flexible loop which can be used for removing cinders and dust. Sterilization does not hurt the magnetic qualities of the instrument, the manufacturer reports.

SOME NON-TRADITIONAL PRACTICES IN TRAINING FOR OUTDOOR LEADERSHIP

WILLIAM GOULD VINAL, "CAP'N BILL"
Emeritus Professor of Nature Education,
University of Massachusetts at Amherst

Presumably, after having trained outdoor leaders for half a century, one has a right to peek into the rear-view mirror. If this magazine has 150 articles per annum, and a reader adopted 50 new ideas a year, that would total 7500 "teaching tricks" accumulated. What I am about to write may not be new at all. If each reader gets one useful thought it will be an above-average contribution. That would make this effort pay good dividends.

A word of caution! Don't swallow all this at one time, i.e. hook, line, and sinker. You had better be a conformist until you have taught at least ten years. Also, as a charitable time-saver, *Don't Read This If You:*

Are preparing students for jobs they will never get, or stuffing them with facts they will never need to know;

Stand pat on a ball-and-chain curriculum, i.e. one textbook dictation, and regurgitating facts in examinations;

Are a wizened (not a matter of age) "closet naturalist," laboring in a brain factory, with no notion of taking field trips;

Have students who creep unwillingly to class because they prefer camping, fishing, hostelling, mountaineering, canoeing;

Send for the truant officer or "Dean," should a student go to a Science Fair, Dog show, Conservation Field Day, or a soap box derby;

Offer a course that has jelled like a hunk of concrete. Evolution is a slow process. Mastadons are in musums;

Believe that science is a "Sacred Cow" where a cadet better not have creative ideas.

PHOTO ALBUM AND CLIPPING BOOK OF OLD GRADS

This visible exhibit of the progression-of-individuals is really worth while. One does not have to have whiskers to be a pioneer. (Imagine my pointing out photos to a class.) This is a photo of the first *ranger naturalist* at Mt. Tom Reservation; this is the first *hotel* nature guide; this fellow started the first *playground* in Belchertown and is now director of recreation in Portland; here is the thirteenth leader of the *Conservation* Van that started visiting camps in 1939; this lady is the assistant principal of the *Belvoir School,* Cleveland Heights and has 13 acres for an outdoor classroom; when KP sat in that seat he did not know that he would be in *Public School camping* at Long Beach;

EW said that he learned more on the *Prairie Trek* expedition that summer than any year in college; this man looks young but he studied *birds* while hunting Japs; this girl was *Red Cross* recreation worker. I'll never forger this *couple*,—they traveled 5500 miles in Europe on a tandem. They will come here and show their kodachromes someday. This one was always interested in *scouting*. These clippings all relate to scouting activities in college. *Hero worship* is something like placing ostrich eggs in front of bantams. Students introduced to "the Album" cannot help but get a wide distribution of space, time, nationality, geography, and placement. The success of a "home-town-boy" stirs up ideas. (Perhaps right then and there a student gets an inception of what he wants to do.)

The Newsletter

This is a mimeographed quarterly, about past and present students. Subscription price was news about one's self. It is a running, anecdotal account of each individual. The story of each student is much more suggestive than past marks. In the summer of '49 juniors and seniors were scattered from the Atlantic to Wisconsin, Maine to Alabama. In the winter of 1950 three "grads" were studying in Pittsburgh. In the Service, when PJ was at Hitler's Eagle Nest, RS was winging over Greenland, JB in Guadacanal, and DE on the high seas. It was good reading. The Director of a Children's Museum in the far south wrote: "I'm not a director with executive ability nor a cleaning woman, and I have to be both—but I get children into the museum and I love 'em all. They help, they pester, they're noisy, they maul the rabbit, they put their grimy hands on the white walls, but they throw their scrap paper in the waste basket, sweep the floor where Dickey eats his acorns, beg to run the movie projector. Golly, I love it."

The newsletter spread the gospel, was a beacon on trends, kept the "family" informed about the trials, tribulations, and successes of each other, and listed new positions. Last, but not least, it was wanted. From the small beginning of the new department in September 1937, it became a 33-page affair in 1949, really too large. When the writer retired in December 1951 it stopped. In a year's time the graduates organized and now have their own newsletter. Functional education marches on.

Public Service

This was a two-way benefit, the public and the student. There were two classes of assignments: The underwriting of a year's service included scouts, boy's clubs, youth centers, Sunday Schools, and hospitals. Amherst is a country town of about 8000 population in the Connecticut Valley. In 1949 there were 17 students serving weekly

500 people. There were 6 at Leed's Veteran Hospital for the mentally sick; 7 Girl Scout leaders; 2 Boy Scout Leaders; 1 Boys Club leader (Paid); 1 South Deerfield Youth Center (paid). Seniors were enrolled in a so-called Problem Course for credit. They were sometimes assisted by juniors who would take over the following year.

Requests for single events usually came by telephone. Some type daily services were: all day bird census at Arcadia Sanctuary; field trips for Southern New England student section of American Country Life Association at Somers, Connecticut; judges for conservation contest of Hampshire County Achievement Day; labeling of Northfield Inn Nature Trail; ushers at Audubon Lecture Series at Northampton; panel for P.T.A. meeting in Springfield; and discussion group on Outdoor Community Recreation at Williamsburg Grange.

All assignments were by request. The rules were simple. No student was to be put to expense. Sometimes two went along, one who had mastered the skill, such as square-dance calling, and an apprentice who wanted to master the skill. Each meeting was elective, extracurricular, challenging, and a practical sociological experience. The student was helped toward maturity as an individual, as a member of a team, and as a citizen. It was recognized as one of the most significant opportunities for experience in leadership.

Creative English

"Nature Guiders" were easy to interest in taking courses in creative writing. They had something to write about and that was half the battle. In the long run, it was those who had their work published that stuck to it. Launching such an objective is much easier than biology teachers may even suspect. In the *Bulletin* (Mass. Audubon Society), March 1950, eight former students appeared in print. Fran Gillotti wrote about "Birds on a Connecticut Farm"; reference was made to the slogan "Learn to enjoy, not destroy" coined by Ev Bergstrom and Ken Pike; Bob Jones reported on the "Wildlife Program of Wildlife Management"; Mary Cedars had a letter; Dorothy Snyder had "School Notes"; and Al Hawkes in cooperation with Jane Sessions had appeared in a panel discussion. In 1948, eight students had short articles accepted for publication in *Camping Magazine* on their most valuable summer experience. One grad had an article in *Recreation* (August, 1943) another "The Best Job in the World," *Berea Alumni Magazine*. Another became editor of the *Lone Scout*. Once under way, creative writing snowballs.

The *Newsletter* was also an outlet for the urge. Joe Brauner wrote, just after getting his master's at University of Southern California: "I have some poor-will nests under observation and am getting unique observations on behavior, also magnificent pictures. It is all night

work. I am beginning to look like a poor-will. However, you can call me 'Poor-Joe.'" Creative writing can become a habit. It is fun. It is an art. It can never happen without opportunity and encouragement.

Surveys

The topics considered so far, in this essay, including Surveys, were presented at the beginning of the fall semester, junior year. Surveys were considered the most valuable experiences. The *Amherst Survey Committee* consisted of the Superintendent of Schools, four professors from the University of Massachusetts; one professor from Amherst College; and two members-at-large from the town. The writer was chairman. Student technicians were welcomed for "leg-work" and "chores" which was really "Field Work." The students considered it a privilege to sit-in on committee meetings and to have a real voice. They selected areas to investigate, such as: Amherst Youth Problems; teenagers in the emergency farm labor program; facts about swimming holes; existing forest and park recreation; school recreation; church recreation; neighborhood characteristics. This involved such techniques as interviews; questionnaires; tours of observation; a census of activities; preparation of maps; diagrams; and graphs. Students were in demand for forums, discussions before civic organizations, and recommendations. A member of the Youth Problems Committee spoke before a group of mothers in a home. Word came back, via the grapevine, that she in effect said: "If you old biddies would get out and play with your children etc." Youth are wonderful. (The Report of the Recreation Survey Committee, 10 pages; *Amherst Town Report*, Jan. 5, 1948.)

Worcester County 4H Camp Survey

This was an all-day affair on Saturday October 20, 1951. It was quite different from the Amherst survey. The survey team was made up of eleven student volunteers. The Camp Committee consisted of outstanding rural leaders: a fruit and poultry farmer; the Director of Extension; a poultry specialist who hatches $\frac{1}{2}$ million chicks and experiments with Dolman Whites; a county banker; a market gardener who had 150 acres; the Girl's worker; director of Worcester County Training School; the county 4H Club leader and wife, a former student. The last two were co-directors of the camp. The order of procedure was a tour of the camp property and the surrounding state forest; a cooperative cooked-meal, enjoyed outdoors; a lively round-table and a written report. This was the day of a "big" football game but no one gave that a thought except to turn on the radio when campus-bound. The 11-page cooperative report was published by

the County Extension Office. One did not need to be a crow sentinel hidden in an old pine tree to observe that this was a functional day, and a meeting of like minds interested in a real, outdoor problem. Every survey was a challenge, different, and attractive enough for students to volunteer time-and-time again.

Schools

A school visitation was a real occasion. It meant the transfer of 30 students by college bus. The observation bee hive will be described as an example of such a trip. Schools visited were in North Amherst, Northampton, Springfield, and Pelham. The objective was to get acquainted with a progressive curriculum. Each student served on a committee according to interest and skill. The committees were as follows: a real hive with frames, queen excluder; observation hive made by some student; hive tools including smoker, veil; charts; compound microscope with slides on tongue, stinger, pollen basket, compound eyes, feeler; comb and bottle products; charts; flowers for the story of cross-pollination. The observation hive was set up in a proper window. The children rotated from station to station. Chalk marks indicated the route of traffic. Perhaps a student taught a honey bee song, or told a story. If weather permitted, we adjourned for a field trip. We saw bees visiting clover, carrying pollen; drinking water; orienteering; and other divisions of labor. Sometimes scout and club leaders invited the children to visit the college apiary. The students were always amazed at the amount of absorption by Fifth Graders, for example. The experience was sure-fire for enthusiasm. It was a new wonder world for the children and teacher. They were fascinated. Often times the superintendent of schools, principal, and teachers came to observe. The students were also stimulated. There was a bona fide reason for knowing their stuff. The children got up a honey bee program and invited the students back. That was a part of the bargain. Films were taken the second time as a surprise. Often times we furnished honey products for a party and finale. The loan bulletins and pamphlets made a good resource library. Sometimes we took film strips on bee culture. The students ran the film and called on the children to tell what each frame illustrated. The children had never seen the film. It was not necessary to alert the children or to enlist them to talk. They were eager to give the significant facts. Any oversight had proper care.

The Week before Christmas Vacation

Every other year Professor Alfred Boicourt spent a lab period with the students making wreaths, center pieces, sprays, and boutonnieres.

They chose their own projects. Several bushels of material were provided from which they selected. The preceding lab had been devoted to making an evergreen key. At the end there was an exhibit and judging. The objectives were conservation, knowledge, beauty, creativeness, and practicability. Those who wished could take the pieces home, to the Dorm, or to a hospital. Left overs were presented to the office staff. There was a steady flow of visitors sauntering in and out. A genuine audience is always an incentive.

Alternate years the students made "keys" on non-flowering evergreens such as mosses, lichens, sphagnum, lycopodiums, and ferns. Wintergreen, partridgeberry, and black alder were added for color. Glass terraria were made and judged. They were sold for the cost of the glass.

It was also a time for an exhibit of home-made, creative Christmas cards, carols, and stories. Christmas meant many things to the many races and religions represented in the class. Some sang carols for the first time. The individuals who were members of the chorale and glee club led. This was undoubtedly the first time that the welkin had been made to ring in old Fernald Hall, at least during a lab period. The sunshine, friendliness, and gladness of student voices on these occasions was truly "peace on earth, good will towards men," long remembered by participants when biological facts might be dim.

Christmas Vacation

No assignments were ever given for vacations. When the students

1949	1950
Model railroad; solo at Xmas party	Led field trip, Reformatory for Women
Led games at Church Party for Students	R.I. Xmas Bird Census; 115 birds seen
Cape Cod Bird Census trip (111)	Visited Blue Hill Observatory
Worked in father's office	Helped church in social work
Gave talk at College Club meeting	Visited Amer. Museum Natural History
Decorated home; Cushing Hospital	Winter camp at Life Camp three days
Planning committee for a party	Visited Jennie Clarkson Home
Messiah Pageant	Directed annual Grange Xmas Party
Was sick; woe is me	Organized Xmas carolling; preached sermon
Wrote letters for a job	Six days of research on thesis
Put on 3 Xmas parties at Youth Center	Saw glass flowers at Harvard
Took civil service examination	Christmas party at church
Quabbin Bird Club census	Substituted at Springfield Day Nursery
Helped at Westboro Hospital party	Made bayberry candles
Built 2 aquaria for Christmas	Ear-tagged and released white hares
Entertained 2 city cousins	Led teenage party
Entertain 18 months old niece	Gave a New Year's Party.
Led teenagers carolling	Worked in a toy depatrment

returned they were asked to write a paragraph or two on what they had done that might relate to their chosen career. No two students did the same thing, nor did the same individual do the same for two years. The results are condensed. They are interesting.

Some conclusions: Opportunities as well as individuals differ. Nature students are not exactly stationary engineers. Professional improvement does not necessarily stop with classes.

Norwich Lake Development Plan

Problem: Northampton Girl Scouts had acquired a 50 acre tract in the Township of Huntington in the Berkshires. 700 foot shore front on Norwich Lake, ½ sand beach, ½ rocky. Proposed to raise $25,000 capital fund; supported by Community Chest. 80 campers in 3 units, youngest, intermediate, and seniors; 6–8 week periods; 1000 foot undeveloped road; winterized infirmary; multiple-use dining hall; pioneer units. Basic philosophy: decentralized camping; to be worked out as a minimum low-cost scale to serve as a camp that other councils might copy; as far as possible to be developed by Girl Scouts and parents on long-term basis; native materials on property to be used so long as they did not interfere with good conservation practice and beauty of site.

Organization: Students signed for one of following committees according to interest and skills: (1) structural geology and topography; (2) rocks, minerals, and soil; (3) land utilization; (4) forest management; (5) waterways, parking lot, roads and trails; (6) location and building of structures; (7) water front. Chairmen were elected. One graduate student chose to do research on the Knightsville Flood Control Reservoir as a resource trip for the campers. An older GI decided on photogrammetry (Aerial photography) on the area. There were always jobs for all capacities.

Basic training: Topographic maps; geological folios; state planning board maps; government reports; literature on camp structures; photogrammetric maps; auto maps; and surveyor's maps were provided. The committees spent a lab session coloring maps; planning what to scout for; what to collect; photographs needed; and on-the-job survey. Each committee worked out individual assignments in order to make a report that would not only be interesting but functional for use by Girl Scouts. There was nothing heretical or antiquarian about the set-up. It was a synthesis of science and the art of camping.

The trip: A holiday was selected so that scheduled programs would not interfere. Some things discovered that could not have been anticipated were: garnets; owl's nest; porcupine dens; types of vegetation; an old mill dam; underground streams; and adjacent properties that

should be acquired to make the scout program more efficient. The Girl Scout Council prepared an excellent noon luncheon. Following the meal each chairman reported the findings which was a basis for a lively discussion. The problem was not make-believe. It was on-the-job training. The students and public had collaborated on a great range of invigorating interests and realistic philosophy of education.

Retrospect: Jim Baird, who had acquired the skills necessary in photogrammetry, presented the 3-dimension photographs to the Girl Scout Camp Committee. He was later a recipient of a scholarship at Rutger's University. The thesis for his doctorate is on the "Development of the Watchung Reservation." Bob Wood, the expedition photographer, became Ranger Naturalist at Crater Lake (summer 1952). Both men were more than camera conscious. They were neither sterile biologists or chronic scientists. Time does not permit calling the complete roll and results. Long after the participants have forgotten the circulation of the blood they will have vivid recollections of a socially enjoyable holiday, and a profitable vacation (not vacancy). Volunteering free time, putting on "fatigues," and the esprit de corps might be classed as attitude, and attitude is as important as breathing or circulation of the blood. Drafting a member of the varsity baseball team; putting a band lady on photogrammetry; or leaving a forester to memorize blood vessels would have been "mal-assignment."

Outdoor Recreation Conference

This was an annual affair held in mid-March. There were 10–15 sections, such as camping, wildlife, nature education; mountaineering. Student committees organized exhibits, folk handcraft-demonstrations, and folk festivals (dancing and singing). A half day, of the three-day Nature Section, was turned over to students. Student panels on decentralized camping, professional opportunities, and public school camping were always exciting. Kodachromes of the conservation van, coast-to-coast rolling youth hostel trips, Girl Scout Mobile Unit, wilderness camping, and orienteering were popular. It was also round-up time for state and national leaders as well as "Old Grads." The home coming of "Sour Dough" Tom Kane '48, who had led a YH Group beyond the Arctic Circle, with "swollen streams and ankles, howling sled dogs, hardships and joys"; his unexcelled kodachromes and humor; will ever be remembered. The conference was a lab experience. It was a "spring opening." It was an inventory of "nature influences" of the past year. It was a fundamental experience in organizing natural and human resources of the New England Region. The annual "Rounding out the cycle" brought students back to campus for years to come—even brought wives or husbands.

Maple Sugar Excursion

This was a circuit trip to the Berkshires on the Sunday after the "Rec" conference. Many out of town visitors stayed over for the trip. It was student engineered and kodachromed. Four camps were visited and the noon meal included the making of maple wax, sugarin' off, maple taffy, and molding maple candy. Hobnobbing with farmers and getting the fine points about cooperatives were valuable.

Distinguished Visitors

Amherst is off the beaten path. This did not prevent distinguished guests who brought warmth and informality. The visit usually had an element of surprise as no activity was too important to postpone. Talks were always followed by discussion. Bjorn Kjellstrom the champion Swedish Cross-country skier; "Gold" Metcalf who rehabilitated service men by tying fish flies; Fernand Lane, author of *The Mysterious Sea;* Alfred Goeschl from the U.S. Zone in Germany; attractive Irmelin Ehrhardt, a German girl refugee who arrived via Switzerland. She wanted to be a "Swineherdswoman" but learned that in Massachusetts it is a man's job.

Alumnus "Frick" Spruijt was born in Holland. He was self-sufficient owner of Trap Rock Farm, Deerfield. He had 37 goats for milk, oxen for power, sheep for mutton and wool, horses for travel, a kiln for making pottery from blue clay, his own carpenter and blacksmith shop; a family orchestra including the dulcima and base fiddle. He was wearing a sweater made from home grown wool. He told about his son riding home from Eaglebrook School with a light on his cap. During the hunting season he was required to blow a horn every 10 minutes.

Self Evaluation

Each Fall, students wrote a self evaluation of the summer's experience. Condensed notes from a Junior's paper are presented. "Supervisor of 50 girls at Jennie Clarkson Home, Valhalla, New York. This position had been held by University of Massachusetts students for many summers. As was true of many work-experiences it was passed on summer after summer, from student to student. The children were neglected, dependent, Protestant, city children. I am a country girl and have had a life of comparative ease. Eleven of the fifty girls were Negro. There is only one Negro in my home town. I am Catholic." The paper was to include problems, how solved, and conclusions.

Sample problems: " (1) A six year old, who had just returned from a broken home, was causing a commotion in the dormitory. She

called out: 'Miss Joan, why don't you go to Hell?' (2) One girl hung soiled linen out the window in order to get a good mark for neatness. (3) I had never been in the New York City Subway. I took seven girls to Coney Island for the day. The girls hoped that I would get lost. I had to depend on a map. (4) The girls were made to go to church. They were very noisy on the bus and there was trouble with discipline."

Some conclusions: "I did a great deal of thinking about compulsion and artificial grades. I gained confidence, realized the importance of a 'doing' program; and that many skills are needed for leadership. The summer was interesting and enjoyable." (Note: This is not hot air. She used her own, hard-earned money for a visit at Christmas time.)

On-the-job: This student was cultured, conscientious, dependable, capable, broad minded, and skilled in outdoor leadership. On graduation she was placed on the YMCA staff in Salt Lake City. This was her choice of work. She had to adjust to a new natural history environment as well as Mormonism. Her fine spirit, breadth of character, and philosophy helped her to be equally successful. She was not catapulted into an entirely new situation. She had had two years of salty experience.

Autobiography

One of the first papers suggested in September was an autobiography by all new students. Concentration in nature education as a major field did not take place until the junior year. Students were accepted into the department on the basis of interest, personality, general skills, and past performance as an outdoor leader. Often times they were vouched for by a student majoring in the work. This will be the skeleton summary of one individual at the end of her junior year: A farm girl, large family, working her way. During first year of major work had done volunteer service in seven towns in four states. During her life had now been in camp for 9 summers, 3 as a leader. Nature was main interest; taking a minor in education as "insurance." Elected 5 courses in education including audio-visual. Also courses in sociology, government, public health, and camping. Field service includes counselor at Life Girls Camp, North Amherst Girl Scout Leader; Whately Halloween Party; conducted 4H social; on committee Nature Department Christmas Party; co-chairman of Folk Festival; social at Amherst Congregational Church; led games at Hatfield Church and Westover Field for Service Men; called Square Dance for State High School Day; played church organ Sundays; active in 4H Campus Club; worked at Faculty Club for Board and Room; social chairman of Sorority. Between times helped father on farm.

CM was an individual. She differed from all other individuals in skills, aptitudes, hobbies, emotions, and experience. She agreed with all other students in basic principles. By end of her junior year she was equipped to enter the field of leadership, to assume responsibility for American citizenship, to inoculate others with the pursuit of happiness, to crusade for ethical values in a democratic society, and to act rationally. CM had good grades. However, that was a small part of her personal history. An anecdotal record such as appears in the *Newsletter*, the album-clipping book, self-evaluations, and autobiographies are far more important. These have been the source of material about CM. Her husband is in the service. She is teaching school in Gander, Newfoundland. It will be noted that students get inoculated with the "travel spirit" early in the course. By nature and by training students are not provincials or isolationists.

National Camp

This story would hardly be complete without mentioning Life Camps and National Camp. The writer was on the staff of National Camp from the start (1940). Some summers there were as many as eight students who were counselors. Each two leaders lived with eight children from lower East side, New York City. Their shelters were tepees, covered wagons, and lean-tos in a woodsy setting. Together they planned meals democratically, cooked outdoors, and shared responsibilities. In a decentralized, pioneer camp the leader necessarily had to be a parent, dietitian, health specialist, psychologist, educator, naturalist, conservationist, swimming expert, and have skills in primitive camping, dyeing, weaving, candle making, foraging, and pottery. After two or more summers as a life camp leader, a student could defend the generalist as opposed to the specialist for a youth leader. Professional survival in the woods with kids from Thirty-Third Street, the kind who look you over like beef on the hoof, is no mean accomplishment.

It was here that students first saw a covered wagon, a farm center for educational purposes, a cobbler's bench, or blacksmith shop when needed. The idea was that if your shoes needed fixing you could fix them, if you wanted ice cream you could get the ice and ingredients and make it, if you wanted chicken you could raise them. If a certain camp needed a goose-neck andiron, and the leader did not have the skill, there was a blacksmith handy to teach the know-how. These students were living education and biology and not talking about it.

Radio

No better medium toward concise speaking can be found. After the first shock of being invited to participate they rose to the occa-

sion. A quote from a grad who came from rural Vermont and obtained a teaching fellowship at the Brooklyn Botanic Garden will explain.

"Two of our youngest were chosen to be on a TV show on hobby night of 'The Small Fry Club'. I went to see that the plant material got there and to brief them on proper info. Much to my amazement I was asked to be on the show too, cause—the MC knew nothing about plants. I am now in process of writing a paper on 'Having Fun with Plants,' because we received so much fan mail. Me! Even get letters from Michigan and Massachusetts. Who would have thought that small town me would be a plant missionary in NYC."

WW was an ardent 4H worker. From birth she was devoted to country living. In college she took a prominent part in camping and religious work. She sang in the chorale. She was awarded the Ellen Eddy Shaw scholarship because of personality, enthusiasm, and capability and not knowledge. Her father claimed that she went to New York City to learn gardening. Adaptability, as well as knowledge, was something that every graduate expected to practice.

Planned Interviews

An interview is a technique. Students learned that in survey work. The time arrived when they would be interviewed. Leaders with poetry in the heart would not only "lay hands" upon rough nature but also upon "rough" seniors. Every spring, those who were to get a degree, expected to be interviewed by "Woody" Sutherland of the National Recreation Association; by Lois Goodrich and Bill Gunn from Life Camps; Russ Mason from Massachusetts Audubon; Mrs. Kendall Bryan from Girl Scouts; YW-YM personnel directors; and on-and-on. These authorities were practiced in sharp questioning. The students were pitted against What? Where? How? When? Why? They knew that the questioner had seen their autobiography; clippings in the album; and anecdotal account. "Things" that students had "lived" could be answered with conviction. They "knew" what they wanted to do for a profession. They considered the interviewers as friends that they had seen and met before—when they visited a year ago, when they spoke to the class, when they were at the Rec Conference. They had heard plenty about last year's interviews via the campus grapevine. An interview was just another step in a wonderful adventure.

Military Service

Serving in the Armed Forces is not a complete loss as there is travel, training, and the GI Bill for those who survive. Being in far places does make the *Newsletter* cherished. Knowing nature not only whiles away the hours but brings refreshment. I wish that space per-

mitted to quote from letters from PMc Red Cross "Charm-and-personality lady" at Fontainbleau, Major Ray S in Iceland signing off with "It is time to take a gander at Aurora Borealis and hit the sack," or PJ at Berchtesgaden saying "The instructors are German Boys—Wehrmacht Ski Troopers—our boys are crazy about them—ambassadors of goodwill." There was "I Saw the Taj Mahal by Moonlight" by Bill Knight; Les Clark on the Alcan Highway; Bill Nutting in the South Pacific; El Wilson, weatherman at Panama. The path one chooses to take with enthusiasm and hopes high, may seem clear, but it may not be certain and not always easy. Chinning the bar in factual biology might put one in the medical corps but I could go on to show that background skills, interests and wishes may mean nothing as to one's destination in the services. In the long run, however, nature leaders are not put on the June market like a crate of lemons. When I see young men wiped out in the days of their youth; when I see continuous world disorder; I can only think of their hopes and the terrific sacrifice. It doesn't make sense. Nature is at least a source of contentment.

The Final Examination

Humdrum biologists! Brace your feet for the greatest shock yet. Students were given a choice of a two hour final where they would "cough up" facts or a two day workshop where they would demonstrate leadership skills. They chose the latter. It was to be a Conservation Workshop with Senior Girl Scouts at the Massachusetts State Camp, Cedar Hill, Waltham.

There was an over-all steering committee. Thirty students signed for the following committees: Finance, food, outdoor cooking, forest use, music, camp fire, Sunday Service, soil conservation, conservation trail, reforestation, wild flowers, exhibits, and the Waltham Field Station. There were 46 "spots" where individual students had responsibility.

Although the original plan called for 50 Senior Scouts, on which to practice, last minute telephone pleas let 110 Girl Scouts under the wire. They were chosen delegates from 40 councils throughout Massachusetts.

The machinery was set up in such a way that the influx of numbers did not upset the program. It did increase the responsibility and enthusiasm, if that were possible. There were innumerable considertions such as transportation, smoking, scout's own which involved different religions, retiring, lights out, quiet, rotation of duties, work committees, camp fire, reports to assembly, square dance, auction of surplus, and final round up. A $2.50 poll tax was decided upon. The Cedar Hill Development Committee voted a $15.00

contingent fund. Two women students were assigned to each cabin of Girl Scouts. The men were housed at the "Log Cabin." The writer's Extension Class at Boston University were to be observers and evaluate the activities.

It must be clear that this "Final" was quite different from the fact-collecting finals that were starting the next Monday morning. The students had spent one or two years preparing to engineer outdoor programs. They had had practice in varying degrees. They were facing a sizeable undertaking to be integrated. The idea was not to fail students but to measure successs. Conservation was basic to defense, and the strength of democracy. The real test was the agreement of the councils that the "scout delegates" were to return to their respective communities and put on a similar program. Because of these two days the students were better prepared for life's program. The graduates of the workshop were awarded the "Conservation Pledge" available from "Outdoor Life," 353 Fourth Ave., NYC 10. If the workshop was judged on how tired the leaders were, satisfactions, or enthusiasm, it was a complete success. A final evaluation might be found in letters about similar occasions held years afterwards.

Conclusions

Like the babbling brook, this presentation could run on forever. The run-of-the-mill procedures have been omitted. It is not claimed that each "novelty," if indeed it is a novelty, is *the* way. Each scheme is *a way*. They are schemes that are available. They are schemes that have worked for the author. They have been illustrated by simple stories about what actually happened. It has been made clear that the outdoors is "a happy hunting ground" for biology. There are many milestones in the march afield with youth. Too many scientists believe that sentiment and generalization belong in the history of science, that these things cannot be applied to "cold science," and that nature study has no place in the laboratory where law is law. The outdoor leader, nevertheless, has the opportunity to make clear that facts are stranger than fiction, he can make Dickens' *Christmas Carol* live; he can inspire through present day men and women students succeeding with the forces of nature; and make learning a wonderful adventure. All biological education does not take place in a school room, in a lecture, or in a laboratory. What Lincoln said at Gettysburg could again be said today about the spirit of outdoor leadership.

P.S. One has to put on educational armor to write in this vane. Remember, that in the end, students have the last word. Learning to live outdoors amically and cooperatively—sharing vision and skills

with carefully selected boys and girls equally ardent, is not exactly sterile biology. This is really socio-biology. It might well be called Human Ecology.

DETERMINATION OF THE FOCAL LENGTH OF A DIVERGING LENS

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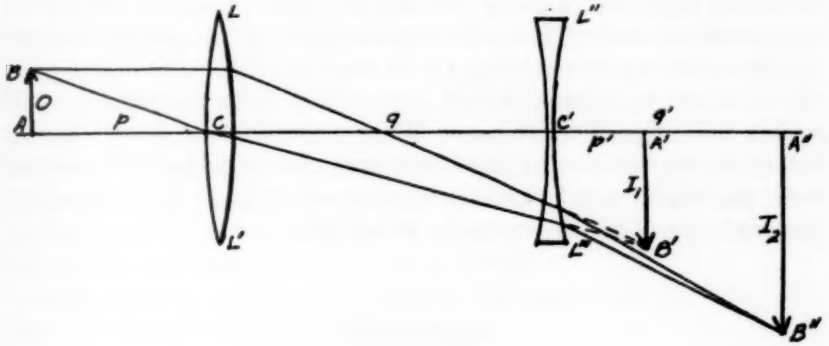
Since a diverging lens forms a virtual image of a real object, it follows logically that such a lens must form a real image of an object which may be considered as virtual. To obtain such a real image, the diverging lens must be used in conjunction with a converging lens as described below with reference to the figure.

A bright object, AB, was set up somewhat beyond the focal length of a converging lens, LL'. A screen was then moved to such a position that a clear inverted image, $A'B'$, was formed upon it. AB, $A'B'$, AC, $A'C$ were all carefully measured and the measurements recorded. The screen was then moved a little to the right of A' and a diverging



lens, $L''L'''$, placed at the left of A' and the same distance from it as the screen. The screen and the lens, $L''L'''$, were then moved slowly apart keeping the distances $A'C'$ and $A'A''$ always equal. In this way a position was found where an inverted image appeared on the screen; where this image was clearest, the distances $A'C'$ and $A'A''$ represented the focal length of the lens. $L''L'''$. At best, this determination usually gives an image that is somewhat hazy and unsuitable for exact measurement, but it provides a fair approximation of the focal length of $L''L'''$ and of the maximum distance $A'C'$ which may be used for accurate determinations.

$L''L'''$ was then moved so that the distance $A'C'$ was between one-fourth and three-fourths the focal length of the lens. The screen was then moved until a clear inverted image, $A''B''$, formed upon it. The similarity of this system to that of the opera glass should be readily apparent. $A'C'$, $A'A''$, and $A''B''$ were all measured carefully and the values recorded. Since the ratios I/O and q/p should be equal, the accuracy of the readings may be determined by comparing these ratios as $A''B''/A'B'$ and $A''C'/A'C'$ which ratios establish the magnifying power of the lens under the specific conditions used. The focal length of $L''L''$ was then determined from the equation,

$$1/-f=1/p'+1/q'$$

or from its rearrangement,

$$-f=p'q'/(p'+q').$$

Since the object of lens $L''L'''$ is considered as being virtual, the negative sign is applied to the p' in solving for f. The value thus determined is then checked by recalculating it from data obtained when $L''L'''$ is placed at at least two other points. The magnifying power of the system as a whole may be obtained from the ratios $A''B''/AB$ or $(A'C \cdot A''C')/(AC \cdot A'C')$.

Any bright object may be used in this work, the glowing filament of a flash light bulb serving well unless measurements of the system as a whole are desired. Since this is often the case, the preferred object was prepared by first cutting a 4-10 mm round hole through a piece of cardboard by means of cork borers. The hole was then covered with a thin piece of white paper. When a burning 60, 75, or 100 watt internally frosted electric light bulb was placed behind this covered hole, the bright spot which it presented served as an excellent object the exact size of which was easily measured.

FILMSTRIPS

"Class Tested Filmstrips," the new and up-to-date catalog of Jam Handy filmstrips is now being released by The Jam Handy Organization. Completely revised and listing every available filmstrip in color or black-and-white produced by The Jam Handy studios, including the latest releases, the catalog is designed to help teachers in their selection of visual aids.

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ARITHMETIC FOR ARITHMETIC TEACHERS

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For one reason or another, an inexcusably large number of prospective and experienced elementary school teachers simply do not know as much arithmetic as they should in order to teach it effectively. We are not particularly concerned here with the reasons for this serious defection, although not the least of the contributing factors is the somewhat annoying overemphasis upon education courses and the considerable disdain with which subject matter courses are regarded in all too many of our teacher education programs today. The present discussion seeks rather to suggest, first, some evidence for the categorical statement that elementary school teachers, by and large, do not really understand arithmetic, and secondly, what colleges and other teacher-education institutions ought to do about it.

DO TEACHERS UNDERSTAND ARITHMETIC?

Some fifteen years ago, describing conditions in New York City, A. E. Robinson (9) observed that "elementary-school teachers have at best only a mechanical knowledge of arithmetic even though they are fairly proficient in their skills in the manipulation of its various mechanical processes. Anything like a clear and versatile knowledge of the fundamental principles of arithmetic and their mathematical significance is all but totally lacking on the part of such teachers." Ten years later, V. J. Glennon (1, 2) gave further evidence of the arithmetic inadequacies of teachers, showing that teachers college students understood only about 44% of certain basic mathematical understandings which he had tested. He observed further that "it is hardly possible for teachers to help children grow in the understandings which they themselves do not possess."

More recently additional testimony has appeared. In 1951, Wilburn and Wingo (10) pointed out that

> In nothing which is taught in the elementary school is it more important that teachers have an adequate understanding of the content itself than in arithmetic Yet it is probable that elementary-school teachers have less insight into the content of arithmetic than into any other subject. . . .
>
> One thing which is probably needed is for teacher-training institutions to pay more attention to providing prospective elementary-school teachers with a better understanding of arithmetic and the number system. At the present time very few of them appear to do this, so the responsibility must fall on those responsible for the in-service training of teachers. The question of methods of teaching arithmetic is an important one in both pre-service and in-service training, *but the understanding of the subject itself is of at least equal importance.* Teachers will not see the importance of changing their methods of teaching unless they have sufficient understanding of the number system to enable them to see the deficiencies in their methods.

Again, in a study of the achievement of students beginning a course in "Arithmetic for Teachers" at the University of Illinois, C. Phillips (8) concluded

(a) lack of achievement in mechanical mastery starts with the topic of fractions and continues with decimal fractions and per cent;
(b) problem-solving achievement involving measurement, fractions, and per cent is very low.
(c) achievement in the meaning and understanding of arithmetic is extremely low.

In a recent and somewhat more elaborate study, J. S. Orleans (7) gave a test to 722 subjects, most of whom were either prospective teachers or student teachers, and a different test to a second group of 322 subjects, about half of whom had taught arithmetic ar various grade levels. According to Orleans:

Data from the two tests . . . suggest on the one hand that many teachers and prospective teachers have difficulty in verbalizing their thoughts when they try to explain arithmetic concepts and processes, and on the other hand that there are few arithmetic concepts and processes that can be readily explained by a large percentage of teachers. . . . It would seem reasonable to conclude that the teaching of arithmetic has become so routinized that whatever understanding is introduced in the learning process is soon lost. Considering the lack of understanding possessed by most reachers, it is doubtful that they can introduce much meaning to the learning process for their pupils.

Orleans suggests that this general lack of understanding of arithmetical processes, concepts, and relationships may result from the practice of teaching a short cut for a process as though it were the process itself. In any event, he is convinced that the findings are not due to the inherent difficulty of arithmetic, but are undoubtedly a function of the way in which the arithmetic has been learned; he reports further that

. . . many of the teachers . . . commented fully, both in class discussions and in personal conference, on their lack of understanding of the basic processes and concepts and on their inability to use arithmetic meaningfully and with confidence.

What Should Be Done About It?

Obviously the situation revealed by these studies must be corrected. More than a decade ago, R. L. Morton (4) saw the need, and proposed, among other things, that

(a) The minimum experience in mathematics of college grade for prospective teachers of arithmetic, should be organized in a year's work of 6 to 10 semester-hours;
(b) The college mathematics experience of prospective teachers of arithmetic should be secured through the medium of courses expecially organized for this purpose;
(c) The teacher of the college mathematics course which is designed for prospective elementary teachers should be a special selection for this purpose; there are many teachers of college mathematics who will not qualify;
(d) A college course in mathematics designed for the professional preparation

> of teachers of arithmetic should be organized cooperatively by a group composed of educators and mathematicians. Such a course should be planned as a six-semester-hour course with prescribed additions for making it an eight-hour course or a ten-hour course.

Later, the Commission on Postwar Plans of the National Council of Teachers of Mathematics, in its final report, pointed out to prospective teachers that in addition to a good methods course in the teaching of arithmetic, it was equally important to have at least one course giving the subject-matter background for the mathematics taught in Grades I through VI, and at least one additional course dealing with the subject-matter background for the general mathematics usually taught in Grades VII and VIII.

F. L. Wren has also stressed the need for adequate understanding of mathematical backgrounds. In a series of stimulating and provocative questions (11), he clearly shows the importance of familiarity with the historical development of numerals, numeration, numbers systems, computational procedures, mechanical aids to computation, and the like; familiarity with the *rationale* of arithmetic, i.e., its logical foundations; familiarity with the social importance of arithmetic, its applications to everyday business, social, economic and vocational demands; and, in general, a thorough understanding of the techniques and generalizations of arithemtic, especially those relating to the number concept, to measurement, to statistics, to computation with approximate data, and to problem-solving. Elsewhere (12) Wren frankly insists that

> Each student preparing to teach in the elementary school has a right to expect that the teacher-training program will provide full opportunity to build up a backlog of information, appreciation, and competency in arithmetic that will enable him to accept this specific responsibility confident that he is prepared to . . . deal with arithmetic with a feeling of security and assurance.

Equally emphatic in demanding that attention be given to subject matter mastery is C. V. Newsom (6), who feels that

> . . . it is possible and desirable to include in the curriculum for the training of elementary-school teachers a minimum of a three-hour course of background mathematics, in addition to a course on the teaching of arithmetic; moreover, a six-hour course is preferred. All too frequently teachers in the elementary grades are hardly a jump ahead of their alert students, and many teachers . . . lack, confidence before their classes in approaching various arithmetical concepts.

Finally, we cite some recommendations by Grossnickle (3):

> (a) Every elementary-school teacher . . . should have a course in background mathematics, preferably six semester hours in length. This course should acquaint the student with the basic principles of the number system, introduce him to both formal and informal geometry, to algebra as a system of generalized number, and to the study of trigonometry as used in indirect measurement.
>
> (b) All teachers in the elementary school, except those . . . in specialized fields, should have a course in the teaching of arithmetic in which both

social applications and mathematical meanings of the subject are treated. . . . This course should be part of a general methods course.

(c) Teachers of arithmetic for Grades VII and VIII should have at least a minor in college mathematics.

(d) Students in liberal-arts colleges who wish to become teachers of arithmetic in the elementary school should be required to meet the same standards of preparation as those who are trainined in teachers' colleges.

A Content Course in Arithmetic

What should be the scope of a course dealing with the subject matter of arithmetic, or elementary mathematics, as fashion decrees it shall be called? How should it be organized? Who should conduct such a course—a member of the mathematics department, or an education staff member? The answers to these and related questions will naturally vary somewhat in accordance with local conditions. But two primary considerations would seem to be (1) the arithmetic knowledge and competence which students bring to the course, and (2) the stated objectives of the course. As for (1), the implications of the data given in the first section of this paper are self-evident; they may be augmented, in a specific situation, by the administration of appropriate tests. As for (2), the determination of the objectives must be governed by professional considerations as well as the realities of pure and applied mathematics. The course content will be carefully chosen to implement the objectives.

The course of study suggested below, while frankly somewhat arbitrary, is based in part on experiences in working with prospective teachers and a consideration of their needs. The résumé is deliberately brief, and is designed more to indicate the scope and spirit of the course rather than to provide a detailed working outline.

COURSE OF STUDY IN ARITHMETIC

I. Number Concept and Numeration
   - A. *Historical Development*
     1. Primitive beginnings; counting
     2. Babylonian and Egyptian notation
     3. Greek notation
     4. Roman notation
     5. Hindu-Arabic system
     6. Modern numeration in Western culture
     7. Numerology
   - B. *Theory of Numeration*
     1. Role of notation in thinking
     2. Base of a number system
     3. Principle of positional value
     4. The empty column
     5. Extension of a decimal system
     6. Exponential notation; number giants and pygmies
     7. Other scales of notation

II. *Nature of Number*
   - *A. Psychological Considerations*
     1. Abstract quality of number

2. Nature of a group
3. Ordinal and cardinal
4. Concrete numbers
5. Operations of arithmetic
6. Laws of operation
7. Interrelationships among operations

B. *Number System of Algebra*
1. Natural numbers
2. Historical development of "artificial" numbers
3. Common and decimal fractions
4. Negative numbers
5. Irradional numbers
6. Complex numbers
7. Relation of arithmetic to algebra

C. *Logical Foundations of Arithmetic*
1. Ordered sets
2. Finite and infinite
3. Denumerability of the natural numbers
4. Rational numbers a denumerable set
5. Non-denumerability of the irrationals
6. The linear continuum
7. Relationship of measurement to number

III. COMPUTATION

A. *Historical Development*
1. Early methods; mechanical aids
2. Mediaeval methods of reckoning
3. Modern methods of computation
4. Computation with approximate data
5. Exponents and logarithms; slide rule
6. Early calculating machines
7. Contemporary electronic computers

B. *Analysis of Theory of Computation*
1. Addition; checks, short cuts, etc.
2. Subtractions; checks, short cuts, etc.
3. Multiplication; checks, short cuts, etc.
4. Division; checks, short cuts, etc.
5. Common fractions
6. Decimals; repeating decimals
7. Percentage

IV. MEASUREMENT

A. *Direct Measurement*
1. Historical evolution of weights and measures
2. Modern standards for units of measure
3. Metric system
4. Mensuration of plane and solid figures
5. Precision measurements; instruments
6. Theory of measurement: error, precision, accuracy
7. Measurement of time

B. *Indirect Measurement*
1. Ratio, proportion, similarity; scale drawings
2. Elements of trigonometry
3. Solution of triangles
4. Surveying instruments
5. Mathematics and aviation
6. Mathematics and navigation
7. Maps and map projections

C. *Elements of Statistics*
1. Graphic methods: categorical and historical

2. Growth curves; logarithmic grids
3. Frequency distributions
4. Measures of central tendency
5. Measures of dispersion
6. Meaning of correlation
7. Concepts of probability

V. Socio-economic Applications

A. *Arithmetic in the Home*
1. Kitchen arithmetic
2. Public utilities
3. Consumer problems
4. Real estate taxes
5. Fire insurance
6. Mortgages; amortization
7. Home ownership costs

B. *Arithmetic in the Market Place*
1. Retail discount; trade discount
2. Commission and brokerage
3. Cost and selling price
4. Margin and profit
5. Mark-up; determination of selling price
6. Depreciation methods
7. Records and accounts; statements

C. *Arithmetic and Finance*
1. Simple interest; accurate interest
2. Bank discount; relationship to interest
3. Compound interest and present value
4. Personal credit; instalment buying
5. Stocks and bonds; investment yield
6. Annuities; capitalization
7. Life insurance principles

I should like to close this discussion with a quotation from the pen of the late Simeon Strunsky, celebrated for his column "Topics of the Times" in the *New York Times*. It is a quotation which I have already used elsewhere, but it is as pertinent today as when it was first written half a dozen years ago:

"Beginning with school children in the first grade, if not actually in kindergarten, and continuing through college and the post-graduate seminars, the one subject in the curriculum which needs to be stressed above all others is arithmetic. It is hard to see how modern man can soberly and usefully attack the terribly complicated problems of his world and age without a firm grasp on the principle that four is more than two, that 90 per cent is more than 10 per cent, that fifty-one nations are more than three nations, and that fifty million war casualties are mote than ten million casualties.

"Sad to say, respect for arithmetic has never stood so low as it does today in this country. People are not content to speak of the three kinds of lies, of which the worst is statistics. They do not stop short at remarking, curtly, that perhaps figures cannot lie but liars can figure. They find that arithmetic is much worse than untrustworthy. They find it a bore. At least this is the caution always addressed to writers for the press and authors of books designed for the general public. Avoid statistics. The public wants its truth presented in broad summations or in vivid anecdote, usually in a combination of both. People simply will not read figures.

"And yet the one problem which has come to transcend every other human interest today, or is described as such on every hand, is a problem in arithmetic. What is this atomic age upon which humanity has entered, if not the age of an

awesome arithmetic? The atomic bomb is our first visible sample of the overwhelming arithmetic in Einstein's formula for the equivalence of matter and energy. To get the energy or force locked up in a piece of matter you simply multiply the mass by the square of the speed of light, that is all. You work out an arithmetical sum in which one step consists of multiplying 186,000 miles a second by 186,000 miles a second. The consequences are Hiroshima and Nagasaki and Bikini; otherwise arithmetic is a bore!"—Simeon Strunsky: in "Topics of the Times," *The New York Times*, Sept. 29, 1946.

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Mineral building material replaces concrete in superstructures and gives 10 times better insulation at the same time. Developed in Sweden, the lightweight material comes in slabs 20 inches wide, up to 18 feet long and from two to 10 inches thick. Like wood, it can be sawed, drilled, cut with an ax and nailed.

THE EYES HAVE IT

IRWIN N. SOKOL
Rawlings Junior High School, Cleveland 4, Ohio

"Did you see the swell pictures in Miss Tury's room today?"

"We learned all about that funny-looking man, Archimedes, today. How queer they used to look in those days."

"Golly, so that's what a meter looks like. They told us about them last year, but this is the first time I really saw one."

"I read about cubits in our Bible, but I never knew how big they were before."

"I wish I had a micrometer like the one we saw today. I could do all sorts of things with it."

Are these remarks like those that come out of your classroom each day, or is this a sample: "I get so tired of seeing those blank, dirty walls all the time. I wish he'd get some pictures or something up there."

"Aw, my teacher's had the same things up for the last five years. My brother was here for Open House and told me so."

Or perhaps you hear, "We never learn any 'real' uses of numbers—only what's in the book. I don't need him to read to me!"

In a report I delivered in April to the Ohio Council of Teachers of Mathematics on "Free and Inexpensive Pictorial Aids to Teaching," my investigation revolved around only one form of visual aid, the chart or picture. I studied most of the published lists of such materials available. (It was amazing how many were utterly useless for the classroom.) I took it upon myself to write to as many of the prominent companies that might have such material as possible. Most of these firms responded, although many of them had very little that could be used or even divulged publicly. Some companies did advertise in various educational and scientific journals that they had certain materials available. These were very helpful. I learned that tools for mathematics classes are not the easiest type to locate.

After wading through envelope after envelope, checking them, and trying to imagine the uses which could be made of this or that chart, I was finally in a position to compile my own list. A few companies were very cooperative in allowing me to display some of their materials for examination by those at the meeting. This saved me a considerable amount of money and at the same time was good publicity for the company. Fair exchange.

The main purposes for using this type of visual aid, as outlined in my talk, are:

1. To create interest in all things mathematical;
2. To open the minds of pupils to new fields and thus encourage investigation;
3. To help the teacher to better explain the phases of the subject under discussion at that particular moment.

One must always keep in mind that these visual aids are not meant to replace the textbook or the teacher, but merely to be momentary or supplementary aids to teaching. They are useful only when they can serve a specific purpose. It is senseless to put material up and leave it there for a whole year or longer. (I know of a case where a teacher had left the same dust-collectors posted for over five years.) A frequent change of scenery is profitable. Just as looking at the same face all the time becomes tiresome, so does looking at the same pictures day after day. Soon the pupil becomes entirely oblivious to the subject and to the meaning of the material.

I have found it a good practice to allow the children to stroll about the room periodically. Perhaps you, too, can reserve ten or fifteen minutes of one day every few weeks to be used for browsing only. Since in most classes pupils must be seated immediately upon entering the room, this browsing time should really be allowed. Otherwise, those for whom the exhibits have been gathered may never see them and one of the main values of visual aids would, of course, be completely lost.

Much material can be pinned on the bulletin board; some may be pasted or fastened on the blackboard with tape. One trick that has proved highly successful has been to magnify important charts or pictures with an opaque projector on the wall or blackboard where a strip of paper has previously been hung. I would then select certain students to trace around the projection, filling in the detail as their talent permits. This usually brings gratifying, large scale results. One thus has a full size picture that can be easily seen, and the picture is in full color. (This may also enable a not-so-good student who may possess drawing ability to have his chance to shine.) Supplementing these with other pupil projects such as small hand-made drawings, clippings and reports, will assure that yours will never be a dull, dim or dreary class.

I found that putting up some good cartoons that have to do with school, and especially with the subject taught, near the more serious pictures, did create the desire that influenced even the most unimaginative pupil to go up and see what was going on.

"Golly, today's Tuesday, and we start our next unit. I wonder what's going to be new this time. You know, the pictures are due to change, too." You can get your pupils to look forward to meeting in your class, too, with a bit of variety in your visual aids. You'd rather

not hear, "Aw, math again! Well, it's another chance to catch up on my sleep."

Keep your subject alive by living with it.

(Anyone interested in receiving my list of "Free and Inexpensive Charts and Pictures in Mathematics" may do so by writing to me at Rawlings Junior High School, 7520 Rawlings Avenue, Cleveland 4, Ohio.)

THE AMERICAN GEOGRAPHICAL SOCIETY OPENS ITS DOORS TO THE SCHOOLS

GRACE E. BARSTOW MURPHY
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An interesting and valuable opportunity is held out to the schools of America, by the American Geographical Society of New York City. Following a hundred years of scholarly isolation, the Society decided at the time of its Centennial in 1952, to share the results of its research with our children through their educational contacts.

From 1852 to 1952, the Society carried on its inquiries and sent its expeditions into every corner of the earth. Data were gathered on a great variety of problems regarding both the lands and seas of the world, and the peoples living on those lands and beside the seas. Through such work, the Society became the foremost treasure-house of geographical knowledge in the United States. Its place is unique among the learned organizations of this hemisphere.

At the headquarters at 156th Street and Broadway, it is possible to glean the most complete knowledge that is anywhere available, on such diverse subjects as climatic conditions in any region on the earth, types of soil, land use, mineral and power resources and the location of raw materials, backward areas where worn-out land creates human misery and consequent social unrest, the incidence of various diseases in near or far localities, the whole subject of Conservation of Natural Resources, political conditions, or any other subject affecting the earth and its population.

The definition of geography has constantly widened. It could be given today as the study of the earth as the home of man. As such, a general knowledge of geography is essential to all of us in this modern, close-knit world. The problems of unrest and need cannot be understood, much less solved, without such knowledge. Because each individual counts in a democracy, it is essential that every one of our children throughout our country should be given the broadest possible comprehension of the geography of our whole land as well as all other lands.

The American Geographical Society recognizes this urgent need and in consequence has opened its doors and its great stores of knowledge to our children. Its small building houses hundreds of thousands of maps and books. Its scholarly staff can make their experience and knowledge come alive in lectures with kodachrome pictures. Its monthly folder, *Focus*, at $1.00 a year, provides geographical information on specific subjects in the current news. The December number was titled: "Resources of the Tropics: 1. Africa." There will presently be numbers on Turkey, Puerto Rico, and France. Back numbers, still available at 10¢ a copy, deal with such subjects as Korea, Venezuela, Japan, Poland, the Outlook for Steel, for Wood, for Water in the United States, Resources of the Arctic, and more. The accuracy of each number can be known to be as exact as is humanly possible, under such auspices as those of the American Geographical Society.

WAYS TO IMPROVE THE READING HABITS OF OUTSTANDING STUDENTS

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Superior academic students are always good readers. Studies have proven this and have further indicated that it is particularly true in the case of students who are outstanding in the field of science and mathematics. Of course some good students have specific reading difficulties, but the usual problem confronting the teacher who wishes to avoid neglecting his better science and mathematics students, is that of getting them to increase the range and maturity of their reading interests. That is, the teacher needs to help them to develop an adult pattern of reading habits. In order to do this, he must help them to get rid of the two immature habits which most strongly act to prevent their developing such an adult pattern.

The first of the two immature habits referred to is the habit of making an absolute distinction between reading for learning and reading for pleasure. The second is the habit of assuming that all acceptable learning is to be found in textbooks. These two habits are closely connected. They seem to be the result of the better student's learning too well the study techniques commonly used in the beginning study of science and mathematics. Of course, family and community cultural patterns are undoubtedly also partly responsible. Regardless of their origin, they prevent the development of habits of broad reading for both pleasure and learning which are necessary for success in scientific and engineering careers—and in many other types of careers, too. So long as students are uncritical of authority as exemplified by textbooks, and so long as they accept the belief that reading for learning is distinct from reading for pleasure, it is impossible for them to develop to the full extent of their abilities.

There is no one guaranteed method of producing this transformation in the reading habits of outstanding science and mathematics students. However, there are many devices which have been employed successfully by a large number of teachers. They include many techniques used to improve the reading habits of average and subaverage students and they may—in most cases—be used in heterogeneous classes with benefit to students of all ability levels. Certainly the procedure outlined below will benefit most students in any class in which it is used.

One of the chief characteristics of all methods of developing better reading habits in superior students, is that the authority of regular texts and reference books is questioned. This is something that can

be done no matter what course is being taught or what text is being used. If it is not possible to find in the text some controversial state ment concerning the subject matter of the course, it will certainly be possible to question the way in which the material is presented. This questioning does not take the form of merely announcing corrections or additions; it involves as far as possible a statement of why the teacher feels that the text cannot be accepted as it stands. The students are frequently reminded that texts are dated and that books cannot be expected to contain discoveries and changes that have taken place since the authors wrote them. The teacher also points out regularly that, since even twenty-volume encyclopedias cannot contain all knowledge, it is impossible for any textbook of reasonable size to present all the facts on a topic. Finally, no opportunity is ever missed for suggesting that authors are only human and that mistakes, bias, and incoherence are just as possible in the written as in the spoken word.

Questioning the authority of the text is as hard on the teacher as it is on the student. It is unfortunate indeed if the teacher questions without being able to come up with a better or more complete version of the material questioned. One way in which the poor pedagogue can take some pressure off himself is by suggesting that students look up additional information on the topic for themselves. This is, of course, also an excellent way to start boys and girls to reading outside of textbooks for information. However, it is not a feasible way unless a lot of books and magazines are available. Hence, the first thing that a teacher does when he wishes to make a serious effort to improve the reading habits of superior students, is to make friends with the school librarian. He acquaints himself with what is available in the library and then brings steady pressure for an expansion of the library collection.

In urging expansion of library facilities, the teacher who is concerned for superior science and mathematics students works for the inclusion of sound semi-popular books on all phases of these subjects. Also, he strives to have a number of advanced texts of a general nature included. (In fact, it would appear to be a good policy for all secondary-school libraries to include in their collections general texts written for the next higher educational level.)

In most communities, the public library is also an important source of reading material for superior students. It is necessary for the teacher also to get acquainted with its librarian and to work for the improvement of its collection from the point of view of the needs of superior students.

Magazines are in a somewhat different category from books insofar as their position in library collections are concerned. Certainly the

school and public libraries are urged by the teacher to subscribe to the better popular and semi-popular scientific magazines such as *Scientific American*, *Scientific Monthly*, *Natural History*, and so forth. However, many more specialized journals occasionally contain material of value for outstanding students and yet are used relatively infrequently, so that it is difficult to justify their inclusion in the library budget. This difficulty is usually met by the teacher's bringing to school his own copies of such magazines. Teachers subscribe to and read many technical or semi-technical periodicals in order to successfully question the text; yet few of them have such large houses that back copies can be stored for very long. Making such copies available to classes is a big improvement over throwing them away, even if only a few students look at them.

Wherever possible, magazines are brought into the classroom rather than stored in the library or left in a cupboard. Once in the classroom, they are spread out on a table or placed in a rack. (It is fairly easy by means of a little unofficial carpentry to convert the lower part of most standard bulletin boards into a small-scale magazine rack.) And, of course, in displaying the magazines care is taken to see that the ones with the most colorful and attractive covers are plainly visible. But display alone is not relied upon to get them read.

Reading periods are a good method of getting students in general to read books and magazines, but superior students should do much more reading than the average. Hence, most of their reading of the magazines made available in class is done outside of the class period. For this reason, all magazines are made available for home use by students. A small file (a corner of a desk drawer is sometimes used) contains three-by-five cards on which students who wish to take out a magazine may write their names, the name and issue of the magazine, and the date they take it. The card is returned to the student when he returns the magazine, thus clearing him of responsibility. From time to time the teacher runs through the cards and calls the attention of students to any that seem to date back an excessively long time.

In addition to depending upon availability and display, magazines are called to the attention of students by more direct methods. When the accuracy or completeness of the text is called in question, reference is made to any relevant magazine material. Also, whenever the teacher comes upon any article that bears upon the work being done in class, he calls attention to it and to its availability. If any student has shown more than average interest in the subject of the article, it is given directly to him with a recommendation that he read it.

Books are treated in a manner similar to magazines. Even those belonging to the library are brought into the classroom from time to

time and briefly reviewed—particular attention being given to information they contain that supplements or contradicts the material included in the official textbooks. In addition, it has been found very helpful to maintain in the classroom a card index of library books related to the courses taught in the room. This consists of duplicates of the regular index cards maintained in the library. Its chief advantage is that suggestions for outside reading are freed from the limitations of the teacher's memory processes. It also has the advantage that suggested library activities can be begun by students at once without delaying until they can get to the library—by which time their interest may have been diverted.

The experience of many teachers has proven that this method of questioning the text in conjunction with a planned program of directing the attention of superior students to easily available magazines and books, is a very successful technique for improving the reading habits of such students. Nevertheless, it has its limitations and teachers who have superior students in their classes should not rely on it exclusively. For instance, the mental partition that many students have developed between instructional and recreational reading is often maintained by a sort of defence mechanism. Too often, students expect that teachers will automatically be critical of the reading material in which they find the most pleasure. When this is the case, exhortations, demands, and enticements, are all relatively ineffective in breaking down the barrier. One of the most successful methods of preventing the development of such a defensive reaction is for the teacher to read and understand material that entertains students. In the case of superior science and mathematics students this is a pleasure for any good teacher, since the most popular reading matter with such students is science fiction.

The mere reading of it is not enough. The teacher also lets the students know that he reads it. Once he has done this, he does not hesitate to express his opinions concerning magazines, stories, and authors. In this way he upgrades the students' taste in science fiction until this reading matter becomes a bridge between entertainment reading and instructional reading. (If anybody doubts that it constitutes such a bridge, he should remember that the better science fiction magazines are next to the *New York Times Literary Supplement* in size of vocabulary used, that they contain factual articles written by leading scientists and scientific writers, and that they are the most popular magazines at such scientific centers as Oak Ridge.)

It is also sometimes necessary for teachers to remind students interested in science and mathematics that the humanities are a vital part of life. In conversation with such students many teachers refer to literature and history and carefully note whether or not their refer-

ences seem familiar to the students. If they do not, these teachers make it quite clear that the consider such ignorance a weakness and that they hold that any scientist or engineer must also be a cultured citizen.

The techniques that have been discussed fit in easily with devices employed to improve the reading habits of students in general. They are employed frequently in connection with supervised study, library assignments, committee work, and so on. Hence, giving special attention to meeting the needs that outstanding students have for the development of better reading habits does not mean giving less attention to meeting the needs of other students. In fact, the average and below-average student may stand in as great need of having his attention called to the fallibility of textbooks as the superior student does.

Of course, the teacher is throwing away a very convenient crutch when he ceases to follow the text. When he says the book is wrong he had better know more than the book! But the extra preparation and effort required is more than repaid by the results. Not only the student, but the teacher also, develops new habits as a result of the use of this method.

NEW OPERATION STOPS BREAST CANCER SPREAD

More women will be saved from breast cancer death if a new type of operation lives up to present promise.

The operation was devised by Dr. Jerome A. Urban of Memorial Hospital for Cancer and Allied Diseases. It is based on the fact that there are two main pathways by which cancer cells spread from the breast to other parts of the body.

One, the primary route, leads to armpit tissues. Conventional breast cancer operations include removal of these.

The second leads to tissues under the ribs, next to the breastbone. Dr. Urban's operation removes this pathway also.

Of 90 patients operated on by the new method during the past 27 months, 41% were found to have had cancer cells spread to the previously unremoved tissues. Final evaluation of the effect on cure rates cannot be made until five years are up.

URANIUM CURE CLAIMS COMBATED BY FOOD & DRUG

Uranium is such a glittering word in this atomic age that thousands of ailing persons were led to pay admission fees to abandoned uranium mines in Montana in the vain hope of being cured of arthritis and related conditions.

When the promoters of this started shipping radioactive ore and treatment devices in interstate commerce, the Food and Drug Administration stepped in and seized the shipments.

The ore, selling for $10 per five-pound sack, gave off fewer gamma rays than the luminous dial of an ordinary wrist watch, FDA tests with Geiger counters showed. The treatment cabinets, valued by the shippers at about $400 each, also emitted very weak radioactivity.

A STUDY OF THE PERFORMANCE OF SELECTED PUPILS IN GENERAL MATHEMATICS IN NEGRO HIGH SCHOOLS OF LOUISIANA

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This report is based on a testing program in general mathematics conducted by the Science Department of Southern University during the second semester of the school year 1953. The general mathematics testing is a part of the science competitive testing program of the Louisiana Interscholastic Athletic Literary Association.

PURPOSE

The purposes of this investigation were to ascertain the effectiveness of the teaching of general mathematics in the high schools which participated in the testing program, and to serve as a means of improving the mathematical instructional program at Southern University.

TECHNIQUE EMPLOYED

A set of study questions was made out by Dr. Leroy R. Posey, Jr., Head of the Mathematics and Physics Department, Southern University, and mailed to participating schools during the first part of the first semester of the school year 1952. The general mathematics study questions were divided into the following areas of mathematics: Arithmetic (this included addition, multiplication, subtraction, and division of decimals, conversion of items in the metric notations to the British notations, etc., and writing prime numbers); Algebra (this included elementary square roots, solving linear equations, multiplication of algebraic expressions, factoring, and the square of fractions); Word Problems (this included solving word problems involving fundamental operations in arithemtic, solving problems using simple algebra).

A teacher-made mastery objective test was administered in general mathematics to the best students selected by the mathematics teachers of the participating schools.

As Mr. William B. Reiner pointed out in a recent article "Tests are given not only for grade purposes, but to help pupils determine their progress."[1] The major purposes of the teacher-made mastery objective test are (1) to raise eventually the academic level of high school pupils in the state of Louisiana, (2) improve the teaching situation in general mathematics on the high school level. The questions for the

[1] Reiner, William B., "Research—Servant or Master?", SCHOOL SCIENCE AND MATHEMATICS, Vol. LIII, Number 2, Whole 463, February, 1953, pp. 154–56.

teacher-made mastery objective test, 41 in number, were made up from the areas listed in paragraph three above.

Participation in the Testing Program

One hundred and sixty-four pupils from sixty-four public schools and four parochial schools, 90 girls and 74 boys, participated in the general mathematics competitive testing program in the state.

Results of Testing

The geographical location of the schools participating gave a good representation of the status of learning in general mathematics in the state. The results of this test in terms of scores reveal a score range for girls of 4.87 to 92; for boys 0 to 88.[2]

Table I shows the percentiles and means.

Table I. Percentiles and Means

Pupils	First Percentile	Second Percentile	Third Percentile	Mean
Girls	56	39	29	39.2
Boys	63.5	44	26.8	39
Total Group				42

Statistical treatment of the data show that the scores in the first percentile for the boys is significantly higher than the girls. This suggests that the boys had gained more information about the areas of knowledge listed on the teacher-made mastery objective test.

The following Table shows the number of questions answered correctly, and the per cent of correct answers by areas:

Table II. Percentage of Questions Answered Correctly

Areas	Number of Questions Presented	Total Number of Questions Answered	Number of Pupils Answering Questions Correctly	Per cent Correct Answers
Arithmetic	16	2624	1371	52.4
Algebra	21	3444	1248	36.1
Word Problems	4	656	92	14

Total Number of Questions—41
Total Number of Students—164

Analysis of Data

This classification of data shows that while the scores of the girls range from 4.87 to 92 and those of the boys range from 0 to 88, the

[2] Scores based on 100 per cent.

upper fourth of the boys performed somewhat better on the teacher-made objective test than the upper fourth of the girls. This can be seen from Table I by comparing the first percentile for the boys and the first percentile for the girls.

Table I also shows the average score for the girls to be 39.2, while that of the boys is 39. The average score for boys and girls is 42, which indicates that the deviations from the mean are negligible.

From Table II, it seems that high school pupils in general mathematics are very weak. This deficiency may be due to the fact that football and basketball coaches are teaching general mathematics in many of the high schools, a fact which suggests that coaches may not have the time to teach well even the rudiments of mathematics because of their efforts in trying to produce championship teams. On the other hand this deficiency may be due to the fact that a number of general mathematics teachers in many high schools majored in everything but mathematics in undergraduate college.

Conclusion and Recommendations

From the statistical data in this study which shows that the scores of the selected students on the teacher-made mastery objective test is depressingly low, it is hoped that through a continuation of this testing program in general mathematics, high school pupils will be stimulated to a greater extent in the desire to master the rudiments of mathematics which is of vital necessity in everyday living.

Insofar as the results of this study are valid, the following recommendations are offered:

1. That the present general mathematics course be improved with an honest attempt to teach well at least the rudiments of mathematics so that high school pupils may be able to meet the mathematical literacy need.
2. That course activities in general mathematics be designed to impart understanding of the essential basic concepts, to give familiarity with the functional topics in mathematics and to create a desirable attitude in mathematics.
3. That high school general mathematics teachers do a better job in teaching their pupils to solve word problems. There should be a greater trend toward the teaching of meaning and understanding in mathematics.
4. That as a means of improving their instructional program, high school general mathematics teachers take advantage on an appropriate in-service training program directed to meet their individual needs.
5. That the competitive general mathematics testing program be continued.

It is certain that a serious attention to the sciences and liberal arts softens and humanizes the temper, and cherishes those fine emotions of which true virtue and honor consist. It rarely, very rarely happens that a man of taste and learning is not, an honest man, whatever frailties may attend him.—David Hume.

DO YOU HAVE A SERVICE STATION HANDY?

E. Wayne Gross
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Lucky is the science teacher who has a service station within a block or two of school. Get acquainted with the owner or manager.* He can help you make your physics class more interesting. If you let him know in advance what you want, he is usually glad to be of help. Being close to school, also permits you to make such a trip during the usual 50–55 minute period.

Measurement is one of the first topics in the physics course. Everything is measured at the station. This could be taught as an observation contest. Have each student observe and jot down the examples he sees of measurement. Then the following day discuss these in class. If you wish to go into detail of how the measuring gauges operate, that is another subject for further study.

For the study of liquids and their properties, the service station has many examples. For instance, the bulk gasoline tanks in the ground aren't allowed to get more than $\frac{2}{3}$ empty except in emergencies. You won't have to do much teaching for the students to realize what would happen in case of a heavy rain. This brings in buoyant force in a practical way. Some students will want to figure out the buoyant force on the tank. The station manager will know the capacity or dimensions of the tank. He will usually have information about the tank's weight.

There are many hydraulic machines used at a service station. The grease rack hoist is one such machine. The fact that air pushing on oil can lift a car is interesting. The concepts of pressure and total force can be straightened out easily. If you wish to go into more detail, write to the company that makes the equipment. They are very glad to send you information about the jack or equipment.

Specific gravity becomes more meaningful when studied at a service station. Some liquids will work best with the pycnometer, others with the hydrometers. What are some of the liquids that can be used? Gasoline—ethyl, regular, and white; kerosene; antifreeze (if he has it in bulk or a can opened); and lubricating oils are just a few of the many liquids. Precaution must be taken to keep the sample clean and return it to the proper container.

Comparative viscosity of liquids can be shown. Use long length of glass tubing (36″ at least and $\frac{1}{4}$″ inside diameter is preferred, but other sizes may be used). Prepare corks to close the ends of the glass tubes. Fill each tube to within an inch of the top with a liquid. Prepare a

* Credit for cooperation in permitting use of his station goes to Mr. Kenneth Isom and the Marathon Oil Company.

tube for each liquid to be used. Then cork the tubes. The air space will form a bubble. As the tubes are inverted, the bubble will rise. The velocity of the bubble will vary inversely with the S.A.E. rating of the oil. If you have small shot or bearings that are only slightly smaller than the glass tubing, they may be placed in the tubing. They will fall at different rates through the liquids. The tubes are long enough that the fall can be timed. Students can also see the relationship of temperature to viscosity.

Composition and resolution of forces can be found in signs, light fixtures, and roof bracings at the station.

The study of machines is more meaningful to students if they're using actual machines as well as the miniature ones in the labroatory. The service station will usually have three or four hand jacks of various types. Have the front or rear of your car weighed at a elevator. Then when the students jack up the front or rear axle, they'll know the value of "*R*" or the force to be overcome. By attaching scales to the handle they can measure their effort. They can also measure the effort and resistance distances. Tire tools, rim debeaders, chain locks, door hoists, and tools are a few of the many other types of machines that can be studied.

Car thermostats furnish an excellent example of how solids expand and contract with changes of temperature.

The station manager can order from his oil company many charts and materials on distillation and preparation of petroleum products. In our case, they also supplied us with an elaborate diagram of the parts of the car engine. Often the station has charts that can be taken to the classroom for a few days for more detailed study.

The battery charger gives an excellent example of current rectification. You can go into electricity and circuits as deep as you wish with this piece of equipment. Again, diagrams are helpful for classroom use.

These are just a few of the areas in a physics course that can be enriched by utilizing the service station. The conduct of the class will determine the welcome extended to you by the station manager. The students should realize that they are guests; that the equipment is worth up to several thousand dollars; that the servicemen have a job to do at the station so that the questions should be asked when they aren't busy.

It is the great beauty of science, that advancement in it, whether in a degree great or small, instead of exhausting the subject of research, opens the doors to further and more abundant knowledge, overflowing with beauty and utility.—FARADAY

CURRENT TRENDS IN RESEARCH ON CARCINOGENIC AND ANTICANCER AGENTS

JOHN R. SAMPEY[1]
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Research on carcinogenic and anticancer agents constitutes one of the monumental achievements of modern medicine. Hartwell[2] has prepared a survey of the 1,329 compounds which have been tested through 1947 for carcinogenic action. Dyer[3] in 1949 listed 5,031 agents in her index of anticancer agents.

The present paper is a tabulation of 382 communications published within the last four years on *in vivo* experiments with carcinogenic agents, and 528 articles on anticancer agents. Through such an approach one may note a number of interesting observations on present trends in this very active field without becoming lost in either the maze of experimental details or the fog of theoretical speculations.

CARCINOGENIC AGENTS

Organic nitrogen compounds and polycyclic hydrocarbons account for two-thirds of the *in vivo* experiments with carcinogens in the current medical literature. Hormones (12%) and inorganic chemicals (8%) represent the next most prevently used cancer-inducing agents. Others are extracts from normal and neoplastic tissues (20 papers), dietary fat (13 papers), tannic acid (6 papers), and viruses (4 papers).

More than a score of different organic nitrogen compounds are represented in the 128 reports on their tumor-inducing properties. Dimethylaminoazobenzenes and aminofluorenes account for one-half of these investigations. Other leading organic nitrogens include urethane (12 papers), anilines (8), nitrogen mustards (7), thiouracil (7), and dyes (5).

Four hydrocarbons—methylcholanthrene, dimethylbenzanthracene, benzopyrene and dibenzanthracene—total more than 100 published reports on the action of these historically potent carcinogens. Concern over the risks run by workers in the petroleum industry is reflected in the 12 studies on the cancer-inducing characteristics of petroleum products.

The vocational hazards of laborers in chromium and beryllium plants account for half the studies on inorganic carcinogens. The

[1] Sampey, J. R., *Southern Med. Jour.* 45, 648–654 (1952); *Furman Studies* 35, No. 3, 18–36 (1952); unpublished data.

[2] Hartwell, J. L., Survey of Compounds Which Have Been Tested for Carcinogenic Activity. National Cancer Institute, Bethesda, Maryland, 1951.

[3] Dyer, H. M., An Index of Tumor Chemotherapy. National Cancer Institute, Bethesda, Maryland, 1949.

newly developed radioactive isotopes gold-198, iodine-131, and phosphorus-32 have brought forth 12 recent investigation on their tumor producing properties.

Sex hormones are widely employed for their anticancer activity. Thirty-one current laboratory and clinical investigations deal with the carcinogenic action of the estrogens, and 8 with the androgens. The pituitary hormone is the subject of 6 reports.

The injection of extracts of normal and neoplastic tissues is a promising method of producing malignant growths in animals. Twenty such studies have been released recently.

The action of dietary fat, tannic acid, and viruses as cancer promoting agents has been the subject of 13, 6, and 4 releases respectively.

Anticancer Agents

Investigations on the anticancer action of organic nitrogen compounds constitute 30% of all publications on *in vivo* experiments with anticancer agents during 1949–52. Laboratory and clinical studies on the retarding of malignant growths through hormone therapy are a close second with 28%. Other major divisions of current research are folic acid analogs and antagonists (12%) and inorganic chemicals (8%).

Among the 160 releases on the tumor inhibiting power of organic nitrogen compounds research on the nitrogen mustards leads with 47 papers. Purines and pyrimidines total 40 releases, urethane 12, and triethylene melamine 19.

Current interest on the treatment of various cancers with sex hormones is seen in 45 publications on androgens and 35 with estrogens. Two other hormones are receiving much attention, with cortisone totaling 41 investigations and ACTH 23.

Aminopterin and A-methopterin are the leading folic acid analogs and antagonists in the treatment of cancer, with the former showing 37 papers, and the latter 15 reports.

Radioactive isotopes constitute the most used inorganic anticancer agents, accounting for 34 of the 43 publications in this promising field. Radioiodine-131 and radiogold-198 lead with 11 and 9 releases, respectively.

There is increasing interest in the cancer-inhibiting action of polycyclic hydrocarbons. Thirty-six current reports deal with the anticancer action of these historically potent carcinogens. Methylcholanthrene, fluorene, benzanthracene, benzopyrene, stilbene and others have been used in the treatment of malignant growths.

Certain bacteria and viruses have shown cancer-inhibiting action. Thirty such studies are to be found in the current medical literature.

The effect of high and low protein diet on tumor growth is a contested question of cancer chemotherapy with 10 releases favoring a low protein diet and 4 a high protein diet.

From current research on anticancer agents we must conclude with Helen Dyer that none of the chemical or biological agents can be hailed as a cure for even a single type of cancer. But the growing interest in this field reflects the hopes of numerous investigators for greater success through continued effort.

RESEARCH IN ASTRONOMY

U. O. Mathematics Letter
The University of Oklahoma, Norman, Oklahoma

The large 100-inch and 200-inch telescopes receive most of the newspaper publicity, but many discoveries are made using smaller telescopes. One of the current research projects in the Department of Mathematics and Astronomy at the University of Oklahoma is the study of variable stars. Certain stars appear to be single stars which vary in brightness from night to night in a regular way. The length of time from brightest phase to dimmest and back to brightest may take a few days, or several months. Photographic and photoelectric measurements are made to establish the amount of the variation and the length of the period. It is known that some of these variable stars are actually systems of two stars moving in ellipses about a common center. More light is received on earth when the pair is broadside than when one obscures (eclipses) the other, hence the variation.

It may also be of interest to readers to know that two galactic nebulae have been discovered recently using the 10-inch telescope at The University of Oklahoma. These nebulae were hitherto unknown. A galactic nebulae is an immense cloud of extremely diffuse gas and dust much larger than our entire solar system. Some of the "blank spots" seen in the milky way are caused by dark nebulae. The two nebulae discovered recently at the University of Oklahoma are located in the constellations Andromeda and Cygnus. Not all astronomical progress is made using large instruments.

RECOGNITION AWARDS FOR SCIENCE TEACHERS

The National Science Teachers Association, a department of the NEA, has announced the third annual program of Recognition Awards for Science Teachers. Awards of $400, $300, $200, and $100 will be given for the best reports of outstandingly good science teaching ideas and practices. Fields of instruction covered by the awards program include elementary science, junior high school science, and all areas of science at the senior high school level. Additional information about the program may be obtained by writing to the National Science Teachers Association, 1201 Sixteenth Street, N.W., Washington 6, D. C.

This program of Recognition Awards for Science Teachers is sponsored by the American Society for Metals and is conducted as a project of the Future Scientists of America Foundation of NSTA. Purposes of the program are: to identify and in a measure reward effective science teaching practices; to help gain greater understanding of the nature and importance of good science teaching at all school levels; and to help encourage retention of good science teachers within the profession.

SCIENTIFIC WRITING AND SCIENTIFIC ATTITUDES

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AND
JACQUELINE V. BUCK
Grosse Pointe Public Schools, Grosse Pointe, Michigan

During the latter part of 1952 and the early part of 1953 the authors of this article were engaged in reviewing research studies published since 1928 that dealt with various aspects of science teaching at the elementary- and secondary-school levels. The review of the literature involved the reading of articles in scientific and educational journals and reports in reference books, as well as the scrutiny of unpublished manuscripts.

The writers of the articles that were analyzed included among others, professors of chemistry, biology and physics in universities, professors of science education in teachers' colleges and schools of education, directors of research in public school systems, and sundry professional educators at various levels. An analysis of these published and unpublished reports (well over four hundred in number) gives rise to a number of interesting observations and points worthy of examination. The authors, of course, do not wish to state that an analysis of all the research articles will necessarily support the points mentioned herein. However, within the limitations of a subjective analysis, the following observations were made:

1. Nearly all the writers indicated directly or tacitly that careful consideration had gone into the isolation of the factors involved in the problem.

2. Most of them professed the intention to obtain sufficient evidence to study the problem and to determine its pertinence to the matter under consideration.

3. Most of them expressed the determination to draw conclusions that were within the limitations of the evidence and to render judgments only when the evidence was sufficient to justify such judgments.

In all fairness it must be stated that, at least in the opinion of the authors of this article, most of the studies adhered fairly well to the points outlined above. However, it was equally interesting to note that a number of writers were somewhat oblivious of the most commonly accepted precepts of research.

The most surprising fact is that the incidence of shoddy research bears little more than a chance relationship to the background of the research worker. Apparently "research-mindedness" is as prevalent

in educators as in scientists, and the lack of such a characteristic is found equally in both groups. A listing of the questionable techniques was made as the authors reviewed the research. A few of the outstanding examples were selected and are presented herein. For obvious reasons the name of the writer will be fictious, and the material, although in quotes, has been paraphrased.

One investigator was desirous of analyzing a series of workbooks in an attempt to determine their contents. In order "to obtain a *representative* sampling" he asked a number of publishers of workbooks the question, "What workbook would *you* recommend for an eleventh-grade course in . . . ?" The invalidity of obtaining a representative sampling by such a technique is obvious.

Another writer obtained his scientific evidence for a widely disseminated report from conversations "on trains, in planes, hotel lobbies, barbershops, and soda fountains," as well as from "a private research project among businessmen and practicioners of the law, medicine and other professions." The only source left inviolate was the habitués of the bar. Such evidence does not lend support to an authoritative voice, but merely justifies a bluster.

In one research investigation, tests whose probable variation from a true score was *five* points were used to measure the achievements of two groups. The difference between the means of the two groups was four points. Yet the investigator found the difference to be significant at the *one per cent level*, or in other words, there was *less* than one possibility in one hundred that the difference could have occurred by chance.

Another scientist in supporting a personal viewpoint makes the astonishing statement, "One carefully analyzed example is better than a score of quotations at random." He then proceeds to select his own example without a whit of effort to show that the example was typical, or to state the procedures used to make "one carefully analyzed example." The example thus chosen is then used as the basis for a vast number of generalizations, which in and of themselves are questionable, even if the example were valid.

In a report of another research study the investigator indicated that while individually a series of items failed to differentiate between two groups, "the items taken as a group probably do discriminate satisfactorily enough to separate atypical students into two groups." There is of course no evidence to substantiate such an assumption, and a good deal of logic to indicate that it is unwarranted. However, in the second part of the study the test is used for the purpose for which the writer postulated its effectiveness.

These, then are a number of the weaknesses found in some of the research studies that the authors of this article reviewed. Such weak-

nesses of course were not found in all studies. Yet it is likely that readers of such studies are apt to attribute to all studies the weaknesses found in some of them.

It would seem fair to state that all persons who do report findings, who consider themselves responsible, and who are assumed to have scientific attitudes must adhere to the established rules of research and personal integrity. There are many guideposts for these investigators. Among them are the following:

1. The necessity of stating clearly the purpose or problem of the research investigation.

2. A collection of data sufficiently thorough so that the results are likely to have a substantial degree of dependability.

3. The use of statistical procedures that make clear the implications of the data, not merely enable the investigator to "grind a sharper edge on his axe."

4. Finally, all conclusions should be formulated in the light of the evidence. In a great number of cases it was obvious that the attitude of the investigator was thoroughly stereotyped and that he had become reaction-sensitive to a fleeting wisp of evidence that was magnified out of its true significance.

If all writers, whether scientists, educators or "hybrids" would follow these guideposts, the respect for all research would be increased immeasurably.

THIRD ANNUAL PROGRAM OF SCIENCE ACHIEVEMENT AWARDS FOR STUDENTS ANNOUNCED

For the third school year in succession, more than one hundred science students in grades 7 through 12 will be awarded cash prizes, gold medals, and certificates in recognition of quality performance in science activities. Plaques will be awarded to schools represented by student winners. Students in public, private, and parochial schools are eligible to enter.

This awards program was developed by the National Science Teachers Association in consultation with classroom teachers, high school principlals, and administrators. It has the approval of the National Association of Secondary School Principals. It is not an essay contest and there are no tests taken. All awards are based on student reports of experimental and investigational work in science or mathematics. Awards are divided equally among eight regions of the country so that students are not competing with "the whole world" but only with fellow students in their own region.

Purposes of the Science Achievement Awards program are: to encourage laboratory and experimental work in science; to help develop early and lasting interest in science; to assist older students in thinking about careers in fields of science and engineering; and, in general, to aid teachers in achieving the commonly accepted goals of science instruction for all students. Additional information about the program may be obtained from the National Science Teachers Association, 1201 Sixteenth St., N.W., Washington 6, D. C.

A MATHEMATICAL INTERPRETATION OF *CROSSING THE LAST FRONTIER*

ETHELBERT W. HASKINS
Benedict College, Columbia, South Carolina

Appearing on page 24 of the March 22, 1952 issue of Collier's Magazine was an article tilted *Crossing The Last Frontier*, by Dr. Wernher von Braun, Technical Directer, Army Ordnance Guided Missiles Development Group, Huntsville, Alabama. This article had to do with the launching of a permanent, man-made satellite that would revolve in the space about the earth at a constant height of 1075 miles up.

Written for the lay reader, the article was adequately expository in reference to the general method of preparing for, and taking-off from the earth, and arriving at the 1,075 mile orbit. This orbit was referred to as the "two-hour orbit" because at the necessary speed to attain permanence the satellite would make a complete revolution about the earth every two hours. Moreover, there were calculations of the amount and cost of fuel to be used, the time to be spent approaching the orbit, the speeds at different stages of the approach, as well as the permanent speed of the satellite.

Considering the average interest of the general reader, the final numerical results, or "answers" were justly considered quite satisfactory. For an individual interested, however, in the mathematical character of the problem, one aspect at least, of the problem must have been cause for concern, namely, how was the speed determined that would render the satellite permanent.

The purpose of this explanation is to consider the mathematics leading up to the "answer" which states that the satellite would have to enter the two-hour orbit at a speed of 15,840 miles per hour to become a permanent fixture there.

Consider first the fact that the path of any ejected body becomes a trajectory the instant the source of thrust is cut off from the body. Two applicable examples would be (1) a bullet shot from a gun, and (2) a stone thrown from a sling.

In the chapter dealing with parametric equations, any treatise on plane analytic geometry will give a detailed development of the equation representing the trajectory (the path of the projected body, or simply the *path of the projectile*). This equation is

$$y = x \tan \alpha - \frac{gx^2}{2v_0^2} \sec^2 \alpha. \tag{1}$$

The letters x and y represent the position of the body, and α the

angle of the trajectory at a given time. v_0 represents the initial velocity at which the body was launched (or projected), and g represents the acceleration of a freely falling body due to the force exerted upon it by gravity.

It is shown in the section dealing with curvature, in any elementary calculus book that the curvature of a function is defined by the equation

$$K=\frac{\dfrac{d^2y}{dx^2}}{\left[1+\left(\dfrac{dy}{dx}\right)^2\right]^{3/2}}. \tag{2}$$

With (1) and (2) the curvature of a trajectory can be determined by the following method. From (1)

$$\frac{dy}{dx}=\tan\ \alpha-\frac{gx}{{v_0}^2}\sec^2\alpha, \tag{a}$$

and

$$\frac{d^2y}{dx^2}=-\frac{g}{{v_0}^2}\sec^2\alpha. \tag{b}$$

Substituting (a) and (b) in (2) gives

$$K=\frac{-\dfrac{g}{{v_0}^2}\sec^2\alpha}{\left[1+\left(\tan\ \alpha-\dfrac{gx}{{v_0}^2}\sec^2\alpha\right)^2\right]^{3/2}}. \tag{3}$$

This is the general curvature of the trajectory.

To impose the conditions of our specific problem on the general equation (3) we reason as follows.

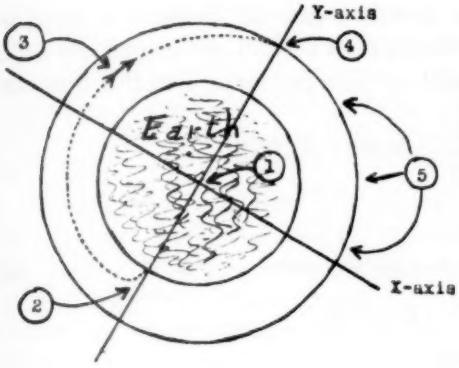
To begin with, place the origin of the coordinate system at the center of the earth, and let the y-axis pass through the point at which the projectile enters the two-hour orbit. (See figure.) At this point $x=0$. α will also equal zero because the trajectory is now parallel to the earth. Thus (3) becomes

$$K=\frac{-\dfrac{g}{{v_0}^2}(1)}{\left[1+\left(0-\dfrac{g(0)}{{v_0}^2}(1)\right)^2\right]^{3/2}}=\frac{g}{{v_0}^2}$$

or simply

$$K=\frac{g}{v_0^2}\cdot \tag{4}$$

It can be seen from (4) that since g is constant, and the orbit is so high above the earth that no atmospheric friction is encountered,



1. Origin of coordinate system
2. Point of take-off
3. Rocket in flight
4. Point of entry into the two-hour orbit
5. The two-hour orbit

the curvature of the projectile is a function of the initial velocity v_0 alone. Further, the orbit must be circular to remain at a constant distance above the earth, and thus its curvature is determined as follows.

If the satellite revolves in an orbit 1,075 miles above the earth it is traveling in a circle whose radius is 5,075 miles.

Again from elementary calculus the curvature of a circle is defined by the equation $K=1/R$, so the constant curvature of this two-hour orbit which we have under consideration is

$$K=\frac{1}{R}=\frac{1}{5075}=.000197,\ =.0002 \tag{c}$$

Next there remains to determine a numerical expression for g. At the surface of the earth g is known to equal 32.2 feet per second^2. However, the acceleration due to gravity varies directly with the mutual attraction between the earth and the body under consideration, and the attraction varies inversely with the square of the distance of the body from the earth. Therefore, *the acceleration of a body toward the earth varies inversely with the square of the distance of the body from the center of the earth.*

Considering the surface of the earth 4,000 miles from its center, a body at a distance of 1,000 miles above the earth would be 5/4 the distance from the center in reference to the earth's surface. This particular body's acceleration due to gravity would be determined in

this way,

$$\left(\frac{4}{5}\right)^2(32)=\frac{16}{25}(32)=20.5.$$

Thus in the two-hour orbit,

$$g=20.5 \text{ feet/second}^2. \tag{d}$$

One other detail remains to be taken care of. Since K is given in radians per mile, and g is given in feet per second per second, *the units must be equated*. g can be changed to miles per second^2 in this manner,

$$\frac{1}{5280}(20.5)=.00388\text{—}=.0039,$$

then we have,

$$g=.0039 \text{ mile/second}^2. \tag{e}$$

A substitution of (c) and (e) in (4) gives,

$$.0002=\frac{.0039}{v_0^2}, \text{ then}$$

$$v_0^2=\frac{.0039}{.0002}=19.5$$

$$v_0=4.41, \text{ or } 4.4 \text{ miles/second.}$$

This is the rounded off figure given by von Braun. Here is a summary of this explanation in a single sentence. If a body enters the 1,075 mile-high orbit with an initial velocity v_0, of 4.4 miles per second, it will remain there permanently as a satellite.

For sundry reasons explained in the Collier's article, the 1,075 mile-high orbit was chosen, and for a thorough appreciation of this explanation, the reader is referred to that article.

The method used to ascertain the velocity of this satellite in its particular orbit can be applied to the launching of a permanent satellite in any given orbit. Further, this method can be extended to determine or account for the average velocity of the moon around the earth, or the velocity of a given planet around the sun. Moreover, if the mean velocity of any satellite around a larger body is known, this method can be extended, provided the proper gravitational attraction between the two bodies is taken into account, to determine the satellite's mean distance from the larger body, or if the distance and velocity of the satellite is known, the attraction between the bodies can be ascertained.

A DEMONSTRATION SHOWING REFLECTION AND REFRACTION OF LIGHT

JOHN W. GREENAWALT
Roosevelt Junior High School, Cleveland Heights, Ohio

There are probably as many devices which satisfactorily demonstrate refraction of light as there are methods for showing reflection. However, there are far fewer ways by which these two phenomena may be presented simultaneously. The advantage of viewing these events at one time is obvious. With a few readily available materials reflection and refraction of light can be shown simply, yet effectively together.

The apparatus needed to perform the experiment consists of a transparent tank (an empty aquarium measuring approximately seven by fourteen inches is ideal), a small plane mirror, some water-soluble fluorescein (three grams is ample), an arc lamp or other light source, a rectangular piece of cardboard large enough to cover the top of the tank, and a few strips of chemically prepared touch paper.

Dissolve a small quantity of fluorescein in the tank which has been filled about two-thirds full of water and place the mirror flat on the bottom of the tank near the center. Fluorescein is especially well adapted for use in the demonstration because of its fluorescent property of appearing yellow when transmitting light and green while reflecting it. Other substances, such as eosin or some of the aniline dyes exhibit somewhat the same properties and could be used, though probably less effectively.

In the cardboard cut a thin slot about one-eighth inch wide and two inches long approximately two inches from one end. The slot should run parallel with the end of the aquarium. Place this cover on the tank so that the slot is on the end nearer the source of light. By holding the touch paper under the cardboard cover, fill the upper portion of the tank with smoke. The smoke is necessary to permit the observer to easily see the passage of light through its first medium, air. The touch paper may be satisfactorily replaced by a lighted punk, a smoldering piece of rope, or even a burning cigarette.

By manipulating the arc lamp and the mirror a beam of light can be directed through the slot so that it is refracted in a yellow line to the mirror where the light is reflected back to the surface of the solution. Here refraction occurs for the second time as the beam of light passes from the fluorescein solution into the smoke-filled portion of the tank. The accompanying diagram illustrates the experiment.

Reasonably accurate measurements of the angles of incidence, reflection, and refraction can be made by taping a transparent plastic

protractor to the front of the tank. A weighted string fastened to the tank serves well as the norm to the mirror.

This demonstration presents rather graphically the principles of reflection and refraction simultaneously. It can be used as an introduction to these phenomena of light or as a problem to be discussed

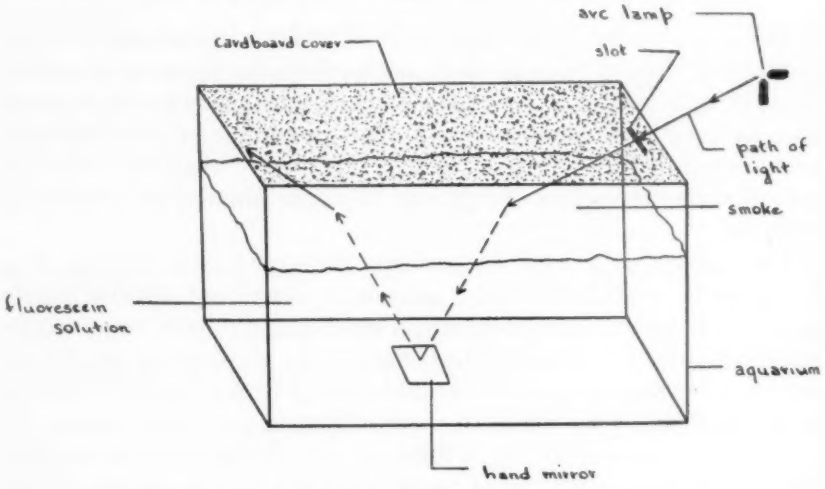


Diagram showing reflection and refraction of light.

after each of these effects has been taught separately. With modifications this experiment can also be used to illustrate the critical angle of water.

CELL RESTRAINING BY CHEMICALS GIVES NEW CANCER HOPE

Hope for chemical treatment of cancer through a new class of compounds is suggested by the American Cancer Society in announcing findings of research it supports.

The finding is that cell division, unrestrained in cancer, can be restrained by chemicals which exist in all living cells. This was discovered in research by Dr. Ernest J. Dornfeld of Oregon State College.

The compounds are called nucleotides. They "come together," explains the cancer society, "to form nucleic acids which, with protein, make up the basic living substance."

Dr. Dornfeld found that two types of cells, those covering embryonic rat ovaries and those in tissues snipped from young rat ears, will almost stop growing if treated with three of the four kinds of nucleotides. The three are cytidylic, guanylic and adenylic acids. The exception, which did not slow cell growth, is uridylic acid.

"Precisely what application this may have to cancer is not yet understood," states the cancer society.

"If," the society's statement continues, "these or related nucleotides exercise a more potent anti-growth effect on cancer cells than on normal cells, or if they completely stop the ever-dividing cancer cells, the nucleotides in some form might be used to treat cancer."

A PHYSICAL SCIENCE DEMONSTRATION
THE PLANETS

LEROY D. JOHNSON
Storer College, Harpers Ferry, W. Va.

Visual aids and play or game situations create desirable ways of learning for students and greatly assist teachers with their programs.

The need for elaborate equipment or a suitable place to carry on demonstrations are often suggested by textbook writers of science.

This demonstration, with its limitations, is designed as a simple way of creating student interest in the junior or senior high school during the study of astronomy, which study may be undertaken in the early fall or spring, in the study of general science.

The teacher may call this the Game of the Planets, or some other title may be used. The place for this game or demonstration is the playground or the gymnasium where space is no problem.

The teacher selects ten students to make ten signs. Each student places the name of the planet assigned to him on the cardboard or paper sign and one student makes a sign with the word *sun* on it.

Using a stick or a piece of metal the teacher draws or has a pupil draw nine concentric rings five feet apart* on the ground to represent the paths of the nine bodies. The student who has labeled the card *sun* is asked to stand in the center of the circles.

The student representing Mercury, the nearest planet to the sun, is placed in its orbit and each student representing a different planet is assigned to one of the circles.

After the nine persons have taken their places they are asked to walk around the circle and return to the spot where they started. By varying the procedure and timing a number of observations may be made by the pupils who are watching as well as by those participating.

When these nine students are familiar with the orderly movements of the heavenly bodies, they can exchange places or new students may be assigned to the demonstration, or to play "Planet."

The desirable outcomes of such activity are many and among these are:

1. Gives opportunity to simultaneously introduce teaching units in art and spelling.
2. Emphasizes outside reading, particularly stories about planets and telling how they got their names.
3. Teaches cooperation and shows the orderliness in nature.
4. Creates a "game" situation, thus facilitating learning.
5. Provides a method of introducing new words and learning the astronomer's meaning of such words as orbit, planet, revolution, year.

* Attention should here be called to the fact that this represents only the order and not the distances between orbits.

WHERE *IS* A RAINBOW?

JULIUS SUMNER MILLER
2116 Benecia Ave., West Los Angeles 25, Calif.

This note reports an observation on a rainbow and raises some puzzling questions. Although I have examined the usual classical discussions which describe the optical requirements I nowhere find any comment or diagram which answers the questions I here raise.

While traveling South in the mountainous terrain of Montana on a hot summer day in mid-afternoon I suddenly noted a rainbow on my left. Its near end was *amazingly* close to our position—some 50 feet off the highway, so it appeared—and it described an elegant semicircle of great brilliance and beauty. I left the car and walked eastward toward the end of the bow which met the ground, to my best judgment, only a few strides away. After some hundred feet of walking, with the bow within my grasp, so to speak, it became clear that the bow did not end on the rocks a few strides away but was, indeed, farther still. The rocks on which it fell were brilliantly colored and this illuminated area was as large, roughly, as a good-sized living room floor. I noted with care that the plane in which the bow lay was very closely an east-west plane (or so it appeared), but as I walked it fell into a north-south plane. The illumination was very high and I expected within a step or two to find myself within the violet band. This was a primary bow with the violet on the inner side. I did not see a secondary bow.

After a trek of some 3 or 4 hundred yards I decided that I was no nearer the end of the bow and the rough terrain impelled me to give up this adventure. At this last position I "felt" that I was exactly *under* the bow near the north end of the sweeping arc which was now somewhat greater than a semicircle, and that the colored band stretched north from my position, the red farthest from me. I cast a few stones in an attempt to approximate the distance but none of these landed within the color zone. Quite bewitched by these observations I stood my ground and formulated the following questions:

1. Where *did* the bow end?
2. Why the staggering illusion as to distance?
3. How wide was the colored band in a N-S plane? in an E-W plane?
4. Could I have been *under* the bow and still have seen it?

NEW RIDER BOOK

Guide to Audio Reproduction, by David Fidelman, a new book from John F. Rider Publisher, Inc., 480 Canal Street, New York 13, N. Y., was published in August.

The author, who has been active in developing commercial and broadcast audio equipment, as well as recording systems and techniques, gives an A to Z explanation of the reproduction of sound. The book starts with the fundamentals of sound and then proceeds to discuss all phases of audio reproduction systems and their requirements. Design, construction and assembly of these systems and their components are fully covered. Comprehensive methods are given for testing the individual units. Full explanations of the circuitry of pre-amplifiers and amplifiers is given along with a complete discussion of pick-up devices (phono cartridges, tuners, and microphones), loudspeakers and enclosures. Charts, tables and graphs keep mathematics to a minimum. A special section on servicing is included. Radio and TV service technicians are given the working "know-how" they need to get into this greatly expanding field. Engineers will value the book for its design charts and testing methods. Experimenters who wish to select and build their own equipment will find practical circuits for home or custom construction, enabling them to build a system tailor-made to their individual requirements.

PROBLEM DEPARTMENT

CONDUCTED BY G. H. JAMISON
State Teachers College, Kirksville, Mo.

This department aims to provide problems of varying degrees of difficulty which will interest anyone engaged in the study of mathematics.

All readers are invited to propose problems and to solve problems here proposed. Drawings to illustrate the problems should be well done in India ink. Problems and solutions will be credited to thir authors. Each solution, or proposed problem, sent to the Editor should have the author's name introducing the problem or solution *as on the following pages.*

The editor of the department desires to serve its readers by making it interesting and helpful to them. Address suggestions and problems to G. H. Jamison, State Teachers College, Kirksville, Missouri.

SOLUTIONS AND PROBLEMS

Note. Persons sending in solutions and submitting problems for solutions should observe the following instructions.

1. Drawings in India ink should be on a separate page from the solution.

2. Give the solution to the problem which you propose if you have one and also the source and any known references to it.

3. In general when several solutions are correct, the ones submitted in the best form will be used.

Late Solutions

2338, 47, 48. *Lester Moskowitz, New York.*

2340. *Henry J. Osner; H. M. Feldman, St. Louis.*

2348. *Clinton E. Jones, Tennessee A. and I. State University; Arthur J. Smith, Jr., Easton, Pa.*

2349. *Bill Leonard, Valparaiso, Indiana.*

2350. *Robert Kerns, Valparaiso, Indiana.*

2352. *Clinton E. Jones, Tennessee A. and I. State University; H. M. Feldman, St. Louis.*

2345. *Proposed by Mrs. J. B. Rooney, East Springfield, N. Y.*

The area of a quadrilateral $ABCD$ with diagonals h and k is C. Find the area of the square, each side of which contains one of the points A, B, C, D.

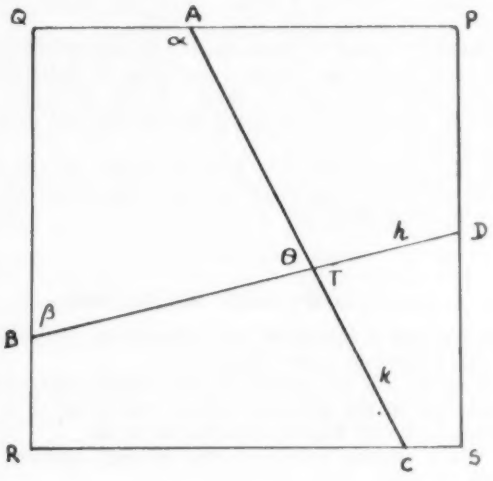
Leon Bankoff offers a solution and comments on this problem, which are now offered.

It is true that from the given data, C, h and k, the species of quadrilateral is indeterminate. It is also true that there exist an infinity of quadrilaterals with vertices not lying on four sides of a square. But for all species of quadrilateral that meet the stated conditions, the area of the circumscribing square is uniquely determined, as shown in the accompanying solution.

The question is readily visualized on an appropriate diagram, if we permit either h or k, or both, to vary their position by letting their extremities slide along the sides of the circumscribed square. Since h, k and the angle between them remain unchanged, the area of the variable quadrilateral is constant as its vertices move along the sides of the fixed square.

Solution by Leon Bankoff, Los Angeles, Calif.

Let $PQRS$ be the required square, with A on PQ, B on QR, C on RS, and D on SP. Call BD, h, and AC, k, and let T be their point of intersection. In the quadrilateral $AQBT$, let $\angle ATB=\theta$, $\angle TBQ=\beta$, and $\angle QAT=\alpha$, whereupon $\alpha+\beta+\theta=3\pi/2$.



Now

$$PQ=h\sin\beta$$

and

$$QR=k\sin\alpha=-k\cos(\theta+\beta)$$

So

$$h\sin\beta=-k(\cos\theta\cos\beta-\sin\theta\sin\beta).$$

and

$$h=-k(\cos\theta\cot\beta-\sin\theta)$$

whereupon

$$\cot\beta=(k\sin\theta-h)/k\cos\theta.$$

Using the relation

$$\sin^2\beta=1/(1+\cot^2\beta),$$

we obtain

$$\sin^2\beta=\frac{k^2\cos^2\theta}{k^2\cos^2\theta+(k\sin\theta-h)^2}$$
$$=\frac{k^2-k^2\sin^2\theta}{k^2-2hk\sin\theta+h^2}.$$

Since $2c=hk\sin\theta$, we have

$$\sin^2\beta=\frac{k^2-\dfrac{4c^2}{h^2}}{k^2-4c+h^2}$$

and the area of the required square,

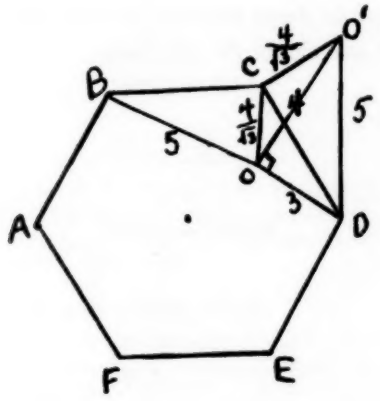
$$h^2 \sin^2 \beta = \frac{h^2k^2 - 4c^2}{h^2 + k^2 - 4c}.$$

2353. *Proposed by Norman Kessner, Brooklyn.*

In the regular hexagon, $ABCDEF$, point O is inside the hexagon with lengths OB, OC, OD respectively 5, $4/\sqrt{3}$, 3. Find the area of the hexagon.

Solution by Martin Schmookler, Scranton, Pa.

Rotate OC counterclockwise 120° to position $O'C$, and draw $O'D$ and $O'O$. $\triangle CO'D$ is congruent to $\triangle COB$ and therefore $O'D = 5$.



Since $\angle OCO' = 120°$, $OO' = 4$.
Therefore $\triangle O'OD$ has a right angle at O, $\angle COO' = 30°$, and $\angle COD = 120°$.
Let $CD = s$ = side of the hexagon. Using the law of cosines in COD,

$$s^2 = \frac{16}{3} + 9 + 4\sqrt{3} = \frac{43}{3} + 4\sqrt{3}.$$

The area of the hexagon equals

$$\frac{3s^2}{2}\sqrt{3} = \frac{3}{2}\sqrt{3}\left(\frac{43}{3} + 4\sqrt{3}\right) = \frac{43\sqrt{3}}{2} + 18.$$

Solutions were also offered by A. R. Haynes, Tacoma, Washington, Julian H. Braun, Washington, D. C. and the proposer; also Richard H. Bates, Milford, N. Y.; Lester Moskowitz, New York; Robert Cawley, Dunmore, Pa.

2354. *Proposed by C. W. Trigg, Los Angeles City College.*

Show that $(N^4 - 2N^3 + 11N^2 + 14N + 24)/24$ is an integer for N positive.

Solution by Aaron Buchman, Buffalo, New York

$(N^4 - 2N^3 + 11N^2 + 14N + 24)/24$ is an integer for N positive if $N^4 - 2N^3 + 11N^2 + 14N$ is divisible by 24, for N positive. But $N^4 - 2N^3 + 11N^2 + 14N = (N^4 + 6N^3 + 11N^2 + 6N) - (8N^3 - 8N) = N(N+1)(N+2)(N+3) - 8(N-1)(N)(N+1)$.

Now $N(N+1)(N+2)(N+3)$ is the product of four consecutive positive integers for N positive and therefore is divisible by $2 \cdot 3 \cdot 4$ or 24, for N positive.

Also $8(N-1)(N)(N+1) = 0$ for $N = 1$; and $8(N-1)(N)(N+1)$ is divisible by $8 \cdot 3$ or 24 for $N > 1$.

Therefore $(N^4-2N^3+11N^2+14N+24)/24$ is an integer for N a positive integer.

Solutions were also offered by Aaron Buchman, Buffalo, N. Y.; Harry M. Geman, Buffalo, N. Y.; Russell H. Godard, Oregon State College; C. W. Trigg, Los Angeles City College; Edward J. Zoll, Levittown, N. Y.; Leon Bankoff, Los Angeles; J. H. Means, Austin, Texas; Julian H. Braun, Washington, D. C.; Rogers J. Newman, Jackson, Miss.; H. M. Feldman, St. Louis, Mo.; Robert Cawley, Dunmore, Pa.; John Jones, Jr., Mississippi Southern College.

2355. *Proposed by Dwight L. Foster, Florida A&M.*

Two circles touch at C, and a point D is taken without them so that radii AC, CB subtend equal angles at D. If DE and DF be tangents, prove by geometry that $DE \cdot DF = DC^2$.

Solution by Aaron Buchman, Buffalo, New York

Draw radii AE, BF, and chords EC, FC. Since

$$\angle ADC = \angle BDC$$

Then

$$DA/DB = AC/CB$$

And

$$DA/DB = AE/BF$$

Thus

$$\Delta DEA \sim \Delta DFB$$

So

$$\angle EDA = \angle FDB$$

And

$$\angle EDC = \angle FDC$$

Let

$$\angle EAC = 2a^\circ$$

and let

$$\angle FBC = 2b^\circ$$

Then, in pentagon $ABFDE$,

$$\angle EDF = (360^\circ - 2a^\circ - 2b^\circ)$$

And

$$\angle EDC = \angle FDC = (180^\circ - a^\circ - b^\circ)$$

But

$$\angle DEC = a^\circ \text{ and } \angle DFC = b^\circ$$

Then

$$\angle DCE = b^\circ \text{ and } \angle DCF = a^\circ$$

Thus

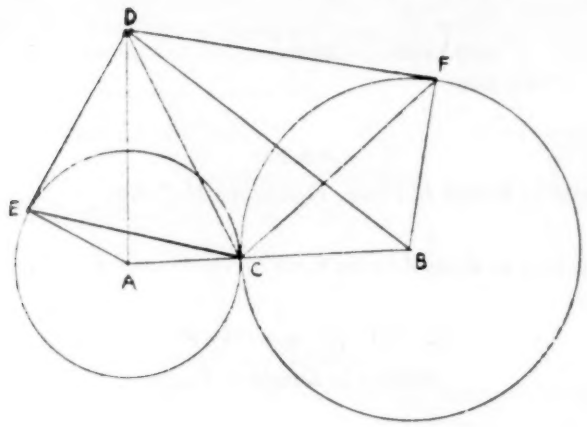
$$\Delta EDC \sim \Delta CDF$$

And

$$DE/DC = DC/DF$$

So

$DE \cdot DF = DC^2$



Solutions were also offered by Aaron Buchman, Buffalo, N. Y.; Julian H. Braun, Washington, D. C.; Richard H. Bates, Milford, N. Y.; Martin Schmookler, Scranton University; A. R. Haynes, Tacoma, Wash.; Leon Bankoff, Los Angeles; Lester Moskowitz, New York.

2356. *Proposed by Hugo Brandt, Chicago.*

From Kasner and Newman's "Mathematics and the Imagination"

About a circle with radius $r_2=1$ circumscribe an equilateral triangle, and about this triangle another circle (radius r_3). Now circumscribe a square about the latter circle, and a circle (radius r_4) about the square. Continue similarly with regular polygons of 5, 6, etc. sides. Find the limit which r_n approaches as n approaches ∞.

Solution by Julian H. Braun, Washington, D. C.

From the geometry of the figure

$$r_n = r_{n-1} \sec \frac{\pi}{n}.$$

Therefore

$$\lim_{n\to\infty} r_n = \prod_{n=3}^{\infty} \sec \frac{\pi}{n}.$$

To evaluate r_∞ we have, on taking the logarithm,

$$\log_e r_\infty = \sum_{n=3}^{\infty} \log_e \sec \frac{\pi}{n}$$

$$= \sum_{n=3}^{\infty} \left(\frac{\pi^2}{2n^2} + \frac{\pi^4}{12n^4} + \frac{\pi^6}{45n^6} + \frac{17\pi^8}{2520n^8} + \cdots \right).$$

Substituting the known values,

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}; \qquad \sum_{n=1}^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90};$$

etc. in the above, we get

$$\log_e r_\infty = \frac{\pi^2}{2}\left(\frac{\pi^2}{6}-1-\frac{1}{4}\right)+\frac{\pi^4}{4}\left(\frac{\pi^4}{90}-1-\frac{1}{16}\right)+\frac{\pi^6}{45}\left(\frac{\pi^6}{945}-1-\frac{1}{64}\right)$$
$$+\frac{17\pi^8}{2520}\left(\frac{\pi^8}{9450}-1-\frac{1}{256}\right)+\cdots$$
$$\doteq 2.1633^+$$

whence

$$r_\infty \doteq 8.700^+.$$

2357. *Proposed by Dwight L. Foster, Florida A&M College.*

If

$$\sin A = p \sin B,\ \cos A = q \cos B,\ \sin A+\cos A = r(\sin B+\cos B)$$

prove that

$$(p-r)^2(1-q^2)+(q-r)^2(1-p^2)=0.$$

Solution by Dwight L. Foster

Since

$$\sin^2 A = p^2 \sin^2 B,$$

and

$$\cos^2 A = q^2 \cos^2 B = q^2(1-\sin^2 B).$$
$$1=(p^2-q^2)\sin^2 B+q^2$$

whence

$$\sin^2 B = \frac{1-q^2}{p^2-q^2}$$

and

$$\tan B = \left[\frac{1-q^2}{p^2-1}\right]^{1/2}.$$

Also

$$r=\frac{p \tan B+q}{\tan B+1}$$

and

$$\tan B = -\frac{q-r}{p-r}$$
$$\therefore \frac{1-q^2}{p^2-1}=\frac{(q-r)^2}{(p-r)^2},$$

whence

$$(1-q^2)(p-r)^2+(1-p^2)\,q-r)^2=0.$$

Solutions were also offered by J. H. Means, Huston-Tillotson College; A. R. Haynes, Tacoma, Wash.; Julian H. Braun, Washington, D. C.; Richard H. Bates, Milford, N. Y.; Sam Bright, Clarksville, Tenn.; C. W. Trigg; Lester Moskowitz, New York.

2358. *No solution has been offered.*

HIGH SCHOOL HONOR ROLL

The Editor will be very happy to make special mention of high school classes, clubs, or individual students who offer solutions to problems sub-

mitted in this department. Teachers are urged to report to the Editor such solutions.

Editor's Note: For a time each high school contributor will receive a copy of the magazine in which the student's name appears.

For this issue the Honor Roll appears below.

2344, 7. *Nathaniel Grossman, Aurora, Ill.*

2343. *Ronnie Brown, Elkhart, Ind.*

Problems for Solution

2371. *Proposed by Marvin Sitts, Flint, Mich.*

Show that the series is convergent:

$$1-\frac{1}{2}+\frac{1\cdot 3}{2\cdot 4}-\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}+\cdots$$

2372. *Proposed by Leon Bankoff, Los Angeles.*

In triangle ABC, altitudes AD, BE, CF, intersect in the orthocenter H. Show that

$$BC\cdot BH\cdot CH+CA\cdot AH\cdot CH+AB\cdot AH\cdot BH=BC\cdot CA\cdot AB.$$

2373. *Proposed by Leon Bankoff, Los Angeles.*

AV, AC, and AD are sides of a regular decagon, hexagon and pentagon respectively inscribed in a circle, diameter AH. E, F, and G are projections of B, C, D, respectively, on AH. Show that $AE=FG$.

2374. *Proposed by W. R. Talbot, Jefferson City, Mo.*

If a and b are used to replace distinct non-zero digits in the decimal system, find their values in the equation

$$(ab)^2+(ba)^2=(2-(ab))^2+(a+b)^2.$$

Show that in a general sense there are an infinite number of solutions. Also what relation between a and b will permit one of them to be negative and still, in a general sense, yield a solution?

2375. *Proposed by Norman Anning, Ann Arbor, Mich.*

If, with A and B both acute Sin $A=0.28$, Sin $B=0.352$, evaluate $3A+2B$ approximately and then exactly.

2376. *Proposed by Isaac Bunn, Pomulus, N. Y.*

In a triangle ABC, prove that

$$a \text{ Sin } (B-C)+b \text{ Sin } (C-A)+c \text{ Sin } (A-B)= \ .$$

BOOKS AND PAMPHLETS RECEIVED

THE CHARACTERIZATION OF ORGANIC COMPOUNDS, Revised Edition, by Samuel M. McElvain, *Professor of Chemistry, University of Wisconsin.* Cloth. Pages ix+303. 14×21 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $4.50.

EARTH SCIENCE, Third Edition, by Gustav L. Fletcher, *Former Chairman, Department of Physical Science, James Monroe High School, New York City,* and Caleb Wroe Wolfe, Chairman, *Department of Geology, Boston University,* Boston, Massachusetts. Cloth. Pages viii+556. 17.5×23 cm. 1953. D. C. Heath and Company, 285 Columbus Avenue, Boston 16, Mass. Price $3.60.

MATHEMATICS FOR THE CONSUMER, Revised, by Francis G. Lankford, Jr., Raleigh Schorling, and John R. Clark. Cloth. Pages ix+438. 15×24 cm. 1953. World Book Company, Yonkers-on-Hudson, N. Y. Price $2.76.

MAN AND HIS PHYSICAL UNIVERSE, by Richard Wistar, *Associate Professor of Chemistry, Mills College, Oakland, California.* Cloth. Pages xv+488. 13.5×21.5 cm. 1953. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $4.75.

YOU AND YOUR INHERITANCE, by Paul F. Brandwein, *Chairman, Science Department, Forest Hills High School, New York City,* and *Instructor, Teachers College, Columbia University;* Leland G. Hollingworth, *Director of Science, Brookline Public Schools, Brookline, Massachusetts;* Alfred D. Beck, *Science Supervisor, Junior High School Division, Board of Education, New York City;* and Anna E. Burgess, *Directing Principal, Formerly Supervisor of Elementary Science, Board of Education, Cleveland, Ohio.* Cloth. Pages vi+464. 15×23.5 cm. 1953. Harcourt, Brace and Company, Inc., 383 Madison Avenue, New York 17, N. Y. Price $3.16.

FUNDAMENTALS OF COLLEGE MATHEMATICS, by Richard E. Johnson, *Associate Professor of Mathematics, Smith College;* Neal H. McCoy, *Professor of Mathematics, Smith College;* and Anne F. O'Neill, *Assistant Professor of Mathematics, Wheaton College.* Cloth. Pages xiv+479. 15×23 cm. 1953. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $6.00.

REAL FUNCTIONS, by Casper Goffman, *Associate Professor of Mathematics, Wayne University.* Cloth. Pages xii+263. 14.5×23 cm. 1953. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $6.00.

BASIC IDEAS OF MATHEMATICS, by Francis G. Lankford, Jr., *University of Virginia,* and John R. Clark, *Teachers College, Columbia University.* Cloth. Pages vii+504. 14.5×22.5 cm. 1953. World Book Company, Yonkers-on-Hudson, N. Y. Price $2.84.

MANUAL OF COMPARATIVE ANATOMY, Second Edition, by Osmond P. Breland, Ph.D., *Professor of Zoology, University of Texas.* Cloth. Pages xi+256. 15×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $4.50.

ELEMENTS OF CARTOGRAPHY, by Arthur H. Robinson, *Professor of Geography, University of Wisconsin.* Cloth. Pages ix+254. 18×24 cm. 1953. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $7.00.

SAMPLING TECHNIQUES, by William G. Cochran, *Professor of Biostatistics, School of Hygiene and Public Health, The Johns Hopkins University.* Cloth. Pages xiv+330. 14.5×23 cm. 1953. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $6.50.

INTRODUCTION TO THE THEORY OF STATISTICS, by Victor Goedicke, *Associate Professor of Mathematics, Ohio University.* Cloth. Pages xii+286. 15×23.5 cm. 1953. Harper and Brothers, 49 East 33rd Street, New York 16, N. Y. Price $4.50.

BEGINNING ALGEBRA FOR COLLEGE STUDENTS, Second Edition, by Lloyd L. Lowenstein, Ph.D., Head, Department of Mathematics, Kent State Universlty, Kent, Ohio. Cloth. Pages xiii+279. 13.5×21.5 cm. 1953. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $3.50.

COLLEGE ALGEBRA, by Jack R. Britton, *Professor of Applied Mathematics,* and L. Clifton Snively, *Assistant Professor of Applied Mathematics, Both of the University of Colorado.* Cloth. Pages x+502. 14×21 cm. 1953. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $5.00.

LOGIC AND LANGUAGE, Second Series, Edited by A. G. N. Flew, *Lecturer in Philosophy, King's College, Aberdeen.* Cloth. Pages vii+242. 13.5×21.5 cm. The Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $4.75.

A SCHOOL COURSE IN MECHANICS, Part II, by A. J. Bull, M.A., *Assistant Mathematics Master, Bryanston School.* Cloth. Pages viii+251. Cambridge University Press, American Branch, 32 East 57th Street, New York 22, N. Y. Price $2.75.

ELEMENTS OF BIOLOGY, by William M. Smallwood, *formerly Head of the Department of Zoology at Syracuse University;* Ida L. Reveley, *formerly Professor at Wells College;* and Guy A. Bailey, *one-time Head of the Department of Science at State Teachers College, Geneseo, New York.* Revised by Ruth Avis Dodge, Past President of the National Association of Biology Teachers. Cloth. Pages viii+746. 14.5×23 cm. 1952. Allyn and Bacon, Inc., 2231 South Park Way, Chicago 16, Ill.

THE FOURTH MENTAL MEASUREMENTS YEARBOOK, Edited by Oscar Krisen Buros. Cloth. Pages xxiv+1163. 18×25.5 cm. 1953. The Gryphon Press, 220 Montgomery Street, Highland Park, N. J. Price $18.00.

PHYSICS, by N. C. Little, Ph.D., *Professor of Physics, Bowdoin College, Brunswick, Maine.* Cloth. Pages viii+648. 17+23 cm. 1953. D. C. Heath and Company, 285 Columbus Avenue, Boston 16, Mass. Price $6.00.

ORGANIC CHEMISTRY, Second Edition, by Ray Q. Brewster, Ph.D., *Professor of Chemistry, The University of Kansas.* Cloth. Pages xii+855. 14.5×23 cm. 1953. Prentice-Hall, Inc., 70 Fifth Avenue, New York 11, N. Y. Price $7.00.

PRINCIPLES OF MATHEMATICAL ANALYSIS, by Walter Rudin, *University of Rochester, New York.* Cloth. Pages ix+227. 14.5×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $5.00.

REVIEWS AND EXAMINATIONS IN ALGEBRA, Second Edition, by Oswald Tower and Winfield M. Sides, *Department of Mathematics, Phillips Academy, Andover, Massachusetts.* Cloth. Pages v+183. 13.5×20.5 cm. 1953. D. C. Heath and Company, 285 Columbus Avenue, Boston 15, Mass. Price $2.28.

SCIENCE IN DAILY LIFE, by Francis D. Curtis, *Professor of Education and of the Teaching of Science, University of Michigan,* and George Greisen Mallinson, *Professor of Psychology and Science Education, Western Michigan College of Education.* Cloth. Pages xii+570. 17×23 cm. 1953. Ginn and Company, Statler Building, Boston 17, Mass. Price $3.96.

COLLEGE CHEMISTRY, A SYSTEMATIC APPROACH, by Harry H. Sisler, *The Ohio State University;* Calvin A. VanderWerf and Arthur W. Davidson, *The University of Kansas.* Cloth. Pages x+623. 14.5×23 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $5.25.

ELEMENTS OF THE DIFFERENTIAL AND INTEGRAL CALCULUS, Revised Edition by William Anthony Granville, Ph.D., LL.D., *Formerly President of Gettysburg* with the Editorial Cooperation of Percey F. Smith, Ph.D., Yale University. Cloth. Pages xv+463. 15×23 cm. 1911. Ginn and Company, Statler Building, Boston 17, Mass. Price $4.00.

PLANT MORPHOLOGY, by Arthur W. Haupt, *Professor of Botany, University of California, Los Angeles.* Cloth. Pages ix+464. 15×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $8.00.

COLLEGE ALGEBRA, by Ross H. Bardell and Abraham Spitzbart, *University of Wisconsin.* Cloth. Pages ix+197. 14×21.5 cm. 1953. Addison-Wesley Press, Inc., Cambridge 42, Mass. Price $3.50.

TECHNIDATA HAND BOOK, by Edward Lupton Page. Cloth. 64 pages. 13.5×22 cm. 1942. The Norman W. Henley Publishing Company, 254 West 54th Street, New York, N. Y. Price $1.50.

ATOMS, MEN AND GOD, by Paul E. Sabine. Cloth. Pages x+226. 13×21.5 cm. 1953. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $3.75.

TEACHING SCIENCE IN THE ELEMENTARY SCHOOL, by R. Will Burnett, *Professor of Science Education, University of Illinois, and Science Editor, World Book Encyclopedia.* Cloth. Pages xv+541. 17.5×25.5 cm. 1953. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $5.75.

OUR NEIGHBOUR WORLDS, by V. A. Firsoff, M.A. Cloth. 336 pages. 15×23 cm. 1953. Philosophical Library, 15 East 40th Street, New York 16, N. Y. Price $6.00.

TRIGONOMETRY, by John F. Randolph, Ph.D., *Professor and Chairman of*

the Department of Mathematics, University of Rochester. Cloth. Pages x+220. 13.5×21 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.00.

PRACTICAL TAXIDERMY: A WORKING GUIDE, by John W. Moyer, *Staff Member, Chicago Natural History Museum.* Cloth. Pages vii+126. 15×23 cm. 1953. The Ronald Press Company, 15 East 26th Street, New York 10, N. Y. Price $3.00.

A LABORATORY MANUAL OF EXPERIMENTS IN PHYSICS, New Sixth Edition, by Leonard Rose Ingersoll, *Emeritus Professor of Physics, University of Wisconsin;* Miles Jay Martin, *Editor Technical Publications, General Electric Research Laboratory, Schenectady, New York;* and Theodore Alton Rouse, *Professor of Physics, Milwaukee Extension Division, University of Wisconsin.* Cloth. Pages xi+286. 14.5×23. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $4.00.

A SURVEY OF MODERN ALGEBRA, Revised Edition, by Garrett Birkhoff and Saunders MacLane, *Professors of Mathematics in Harvard University and the University of Chicago.* Cloth. Pages xi+472. 13.5×21 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $6.50.

FUNCTIONAL MATHEMATICS, Book 1, by William A. Gager, Mildred H. Mahood, Carl N. Shuster, and Franklin W. Kokomoor. Cloth. Pages xiv+434. 15×23 cm. 1953. Charles Scribner's Sons, 597 Fifth Avenue, New York 17, N. Y. Price $2.96.

FUNCTIONAL MATHEMATICS, Book 2, by William A. Gager, Charlotte Carlton, Carl N. Shuster, and Franklin W. Kokomoor. Cloth. Pages xv+447. 15×23 cm. 1953. Charles Scribner's Sons, 597 Fifth Avenue, New York 17, N. Y. Price $2.96.

FUNDAMENTALS OF PHYSICAL SCIENCE, Third Edition, by Konrad Bates Krauskopf, *Professor of Geochemistry, Stanford University.* Cloth. Pages xii+694. 15×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $6.00.

CALCULUS, by C. R. Wylie, Jr., *Professor and Chairman, Department of Mathematics, University of Utah.* Cloth. Pages x+565. 15×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $6.00.

RINEHART MATHEMATICAL TABLES, FORMULAS AND CURVES, Enlarged Edition, Compiled by Harold D. Larsen, *Professor of Mathematics, Albion College, Albion, Michigan.* Cloth. Pages viii+280. 14×21 cm. 1953. Rinehart and Company, Inc., 232 Madison Avenue, New York 16, N. Y. Price $2.00.

FREEDOM AND PLENTY: OURS TO SAVE, by Wilfrid S. Bronson. Cloth. 124 pages. 16×20.5 cm. 1953. Harcourt, Brace and Company, 383 Madison Avenue, New York 17, N. Y. Price $2.95.

CLIMATE, VEGETATION AND MAN, by Leonard Hadlow, B.A., *Senior Geography Master, Burnage High School, Manchester, England.* Cloth. 288 pages. 13.5×21 cm. 1953. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $4.75.

THE SOCIAL INSECTS, by O. W. Richards, M.A., D.Sc., *Reader in Entomology In the University of London, London, England.* Cloth. Pages viii+204. 13×19.5 cm. 1953. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $4.75.

FATIGUE OF METALS, by R. Cazaud, *Ingénieur du Conservatoire National des Arts et Métiers, Docteur de l'Université de Paris.* Translated by A. J. Fenner, B.Sc. (Eng.), A.M.I., Mech.E., *Division of Atomic Energy (Production) Ministry of Supply.* Cloth. Pages xiv+334. 16×25 cm. 1953. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. Price $12.50.

PHYSICS, PRINCIPLES AND APPLICATIONS, Second Edition, by Henry Margenau, Eugene Higgins, *Professor of Physics and Natural Philosophy, Yale University;* William W. Watson, *Professor of Physics and Chairman of the Department, Yale University;* and C. G. Montgomery, *Late Associate Professor of Physics, Yale*

University. Cloth. Pages xii+814. 15×23 cm. 1953. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. Price $7.50.

EXPERIENCES IN PHYSICS, by Hyman Ruchlis, *Chairman of the Science Department, Bushwick High School, New York City*, and Arthur Lazarus, *Forest Hills High School, New York City*. Paper. Pages iv+284. 19.5×28 cm. 1953. Harcourt, Brace and Company, 383 Madison Avenue, New York 17, N. Y. Price $1.96.

MATHEMATICAL RECREATIONS, Second Revised Edition, by Maurice Kraitchik. Paper. 330 pages. 13×20.5 cm. 1953. Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. Price $1.60 Paperbound, $3.00 Clothbound.

YOUTH—THE NATION'S RICHEST RESOURCE—THEIR EDUCATION AND EMPLOYMENT NEEDS. A Report Prepared by the Interdepartmental Committee on Children and Youth of the Federal Government. Paper. Pages x+54. 15×23.5 cm. Superintendent of Documents, U. S. Government Office, Washington 25, D. C. Price 20 cents.

33 YEARS OF PIONEERING AND PROGRESS IN RADIO AND TELEVISION. Paper 94 pages. 21×28 cm. 1953. Radio Corporation of America, RCA Building, 30 Rockefeller Plaza, New York 20, N. Y.

MAC MALLARD, by R. W. Eschmeyer. Paper. 50 pages. 12.5×17 cm. 1953. Fisherman Press, Inc., Oxford, Ohio. Paper-bound 50 cents, Deluxe Cloth $1.00.

AL ALLIGATOR, by R. W. Eschmeyer. Paper. 49 pages. 12.5×17 cm. 1953. Fisherman Press, Inc., Oxford, Ohio. Paper-bound 50 cents. Deluxe Cloth $1.00.

WILLIE WHITETAIL, by R. W. Eschmeyer. Paper. 49 pages. 12.5×17 cm.1953. Fisherman Press, Inc., Oxford, Ohio. Paper-bound 50 cents, Deluxe $1.00.

WOODY WOODCOCK, by R. W. Eschmeyer. Paper. 50 pages. 12.5×17 cm. 1953. Fisherman Press, Inc., Oxford, Ohio. Paper-bound 50 cents, Deluxe $1.00.

PROBLEMS IN BIOLOGY TO ACCOMPANY ELEMENTS OF BIOLOGY, by Greene and Bailey. Revised by Robert A. Green. Paper. Pages iv+236. 19×25.5 cm. 1953. Allyn and Bacon, Inc., 2231 South Park Way, Chicago 16, Ill.

THE ORIGIN OF LIFE, Second Edition, by A. I. Oparin, *Associate Director, Biochemical Institute, U.S.S.R. Academy of Science*. Translation with Annotations by Sergius Morgulis, *Professor of Biochemistry, University of Nebraska, College of Medicine, Omaha*. Paper. Pages xxv+270. 12.5×20.5 cm. 1953. Dover Publications, Inc., 1780 Broadway, New York 19, N. Y. Price $1.70 Paper, $3.00 Cloth.

EFFECTIVE TEACHING, A MANUAL FOR ENGINEERING INSTRUCTORS, by Fred C. Morris, *Virginia Polytechnic Institute*. Paper. Pages ix+86. 15×23 cm. 1950. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y.

EDUCATION FOR THE TALENTED IN MATHEMATICS AND SCIENCE, A Report Prepared by Kenneth E. Brown, *Specialist for Mathematics*, and Philip G. Johnson, *Specialist for Science* (*Secondary Division of State and Local School Systems*. Bulletin 1952, No. 15. Pages vi+34. 15×23 cm. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 15 cents.

SELECTED SCIENCE TEACHING IDEAS OF 1952, Edited by R. Will Burnett, *Professor of Science Education, University of Illinois*. Paper. 57 pages. 21.5×28 cm. 1953. National Science Teachers Association, 1201 Sixteenth Street, N.W., Washington, D. C. Price $1.50.

CHARTERS OF FREEDOM. Paper. 12 pages. 28×25.5 cm. National Archives and Records Service, General Services Administration, Washington 25, D. C. Price 25 cents.

Flashlight bulbs throw either a flood or a spot of light at the flick of a switch. Designed to work in special two-cell flashlights, the lamps have two filaments much like sealed-beam automobile headlights.

BOOK REVIEWS

GENERAL MATHEMATICS AT WORK, by Claude H. Ewing and Walter W. Hart. Cloth. Pages vi+266. 15.5 cm.×22.5 cm. 1952. D. C. Heath and Company, Boston, Mass. Price $2.80.

The authors state that this text is designed for students of vocational and technical high schools and for certain groups in general high schools, and that it is particularly effective in developing general mathematical understandings and skills. It is true the text does contain a wealth of material and would be good for use if the instructor were the very best. It needs a great deal of supplementary work if understandings are to be developed. The work with measurement is basic and yet we find the text stating that π should be used as $3\frac{1}{7}$ whenever the measure is devisable by 7; that measure is *usually* approximate; that we use π as 3.14 in finding the diameter of a circle when the area is 63.59 square inches. It seems the text would have been more valuable if it had helped the student develop a method of deciding what approximation to use.

The drawings and problems are excellent, with a vocabulary as simple as possible under the circumstances where many industrial uses are presented.

The content covered is broad and applicable to construction and industry. The discussion and explanation of precision measuring instruments are excellent and include such instruments as: gage blocks, micrometers, calipers, bevel protractors, carpenter squares, sine bars, and others.

The graph is used very effectively to show functional relationships. Division as partition and as measurement is clearly explained. The field of mathematics covered goes from arithmetic to trigonometry. The book is well indexed, with tables of equivalents, squares, square roots, denominate numbers, and trigonometric functions.

This text would be very valuable as a source book and it probably would serve as an excellent aid for adults in industry, but as a high school text to develop understanding, it leaves much to be desired.

PHILIP PEAK
Indiana University
Bloomington, Indiana

NEW PLANE GEOMETRY, by A. M. Welchans and W. R. Krickenberger, *Arsenal Technical High School, Indianapolis, Indiana.* Cloth. Pages viii+568. 14×20 cm. 1952. Ginn and Company, Chicago, Illinois. Price $2.52.

The text is based on the authors' previous *Plane Geometry* and is not radically different. The changes in order and content which have been made improved the book's teachability and structure. The number of problems has been slightly decreased with the best ones being retained. The text provides for maximum and minimum courses through differentiated lists of exercises and starred theorems. The emphasis on techniques used in reasoning and their related problems has been increased considerably in this text. More theorems have been postulated than in the previous text; this in most cases has improved the value of the text.

A section has been added which includes discussions and problems on aeronautics, 25 pages; maps, 15 pages; and orthographic projection, 6 pages. This material could be very valuable to the teacher if used throughout the course.

The drawings are good, the pictures appropriate and the summaries adequate. As in the previous text, each chapter has timed tests of several types. The authors have maintained their high level of textbook writing in this book, which will fit the needs of any geometry class.

PHILIP PEAK

METHODS OF STATISTICAL ANALYSIS, Second Edition, by Cyril H. Goulden, *Chief of the Cereal Division, Central Experimental Farm, Ottawa, Canada.* Cloth. Pages vi+476. 14.5×23 cm. 1952. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $7.50.

The author has recognized that in any field of mathematics, but particularly in such a rapidly developing field as statistics, every teacher has his idea of what a text should cover, hence an author must adopt somewhat of a middle ground. This particular book is to quote the author, " . . . slanted toward the needs of the student who is now or eventually will be a research worker." It presupposes a sound foundation of algebra, geometry, and trigonometry.

Following an introductory chapter which discusses among other topics mathematical ideas needed in statistics (including matrices and determinants), the author enters into a rather condensed discussion of descriptive statistics, including the arithmetic average, standard deviation, measures of skewness and other variations from the normal.

Some idea of the general scope of the text may be indicated by listing certain chapter headings: Tests of Significance, Analysis of Variance, Linear Regression Analysis, Correlation, Partial and Multiple Regression and Correlation, Analysis of Covariance, Non-Linear Regression, Basic Experimental Designs, Factorial Experimentation, Probit Analysis, Quality Control and Sampling for Inspection and Verification. Rather obviously, the text could not be covered in most courses, or even in two courses, but it does provide an excellent reference source.

Illustrative material comes largely from the fields of botany, biology, or agriculture. At the end of each chapter there is a list of from five to over twenty references.

This book has a very definite emphasis upon the subject of experimental design. Topics sometimes treated in an elementary text but not covered include: graphic presentation, median, mode, average deviation, percentiles and quartiles. The number of exercises is relatively small, but sufficient to illustrate many of the principles involved. If the teacher desires alternate sets of exercises, the book will have an insufficient number.

CECIL B. READ
University of Wichita

DYNAMIC SOLID GEOMETRY, by David Skolnik, *Chairman, Department of Mathematics, Central Commercial and Technical High School, Newark, New Jersey*, and Miles C. Hartley, *Assistant Professor of Mathematics, Chicago Undergraduate Division, University of Illinois*. Cloth. Pages viii+231. 15×23 cm. 1952. D. Van Nostrand Company, Inc. 250 Fourth Avenue, New York 3, N. Y. Price $2.48.

Although the author emphasizes that this text is suitable for a course which emphasizes originals and numerical exercises rather than proofs of propositions, the reviewer's impression was that the book tends toward the traditional approach which emphasizes logical proofs. A suggested outline of a short course of 36 lessons is included (even this is more than can be included in some situations).

There is an ample supply of exercises, some of which are indicated as "superior work... From time to time there are review exercises; likewise lists of new terms which the student should know.

To the reviewer, one of the most valuable features of the text is the use of concepts and definitions which the student will find valid, with no need for modification, in his later work. To illustrate one might mention the definition of a ruled surface (and a special case, the cylindrical surface); the use of a trapezoidal rule; the definition of the sphere as a surface of revolution. One exception to this is noted when on page 120 the author lists the only graphs that may result from plotting a second degree equation in x and y, but omits a single line, two parallel lines, and a single point (his sketch of a hyperbola is inaccurate).

As with any text, the teacher should make a careful examination before adopting—this one is certainly above average.

CECIL B. READ

AN INTRODUCTION TO STATISTICS, by Charles E. Clark, *Associate Professor of Mathematics, Emory University*. Cloth. Pages x+266. 15.5×23 cm. 1953.

John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $4.25.

The author states in his preface that this book is written for the individual not actively engaged in research, yet who needs a sufficient appreciation of statistics to enable him to read the literature of his field. It may also serve as an introductory text in statistics.

Perhaps the most unusual feature for an introductory treatment is the space devoted to statistical inference rather than to descriptive statistics. For example, there is no treatment of graphic presentation, reference to the index shows no mention of such terms as median, mode, geometric average, average deviation, skewness, quartiles, kurtosis.

Following an excellent brief introductory chapter, the author devotes some thirty-five pages to the subject of permutations, combinations, and probability It is stated that the text can be read without a background of high school algebra. This is probably (the word is not used in the technical sense), true, but many readers without such background will be frightened away by the notation.

The reviewer was particularly pleased with the distinction between a frequency distribution and a probability distribution; with the author's definitions of three kinds of probability; with an excellent introduction to the problem of the significance of the difference in means; and by the extensive list of answers and solutions to the exercises—these are much more than mere answers in that they often show why a certain analysis or solution is used. Some idea of the scope of material may be indicated by the fact that there is discussion of analysis of variance, the *F*-ratio, and a chapter on "Inferences from Chi Square."

Whether the book is suitable as a text will depend on what emphasis is desired. Certainly for the non-mathematician it seems to offer a very find discussion of statistical inference.

CECIL B. READ

NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS, by William Edmund Milne, *Professor of Mathematics, Oregon State College.* Cloth. Pages xi+275. 14.5×23 cm. 1953. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $6.50.

Although there may be courses in which this book would serve as a text, its greatest use will probably be as a reference work. It will serve for either the individual who wishes information about a single method which will solve a problem or for the reader who wishes to know something about the principal alternative methods available. To follow the text with any degree of satisfaction, the reader needs a basic elementary course in differential equations as background, plus some knowledge of functions of a complex variable. There is a chapter on linear equations and matrices, emphasizing those topics bearing on the subject matter of this book.

There are numerous illustrative examples, together with a number of exercises which would be helpful if the book is used as a classroom text. Approximately half the text is devoted to ordinary differential equations and half to partial differential equations. Appendices discuss round-off errors, large-scale computing machines, and the Monte Carlo method.

Since there is nothing available in a single book which would even begin to give the coverage of the subject which is provided here, even if not selected as a text, the book will fill a need in almost any college or university reference library. In the bibliography the author furnishes what he calls a short list (260 items including more than 30 books) of books and articles dealing with the topics of his book.

The typography is in general excellent, in a few places an ink smudge appears in the space between words.

CECIL B. READ

INTRODUCTION TO THE FOUNDATIONS OF MATHEMATICS, by Raymond L. Wilder,

Research Professor of Mathematics, University of Michigan. Cloth. Pages xiv +305. 15.5×23 cm. 1952. John Wiley and Sons, Inc., 440 Fourth Ave., New York 6, N. Y. Price $5.75.

This book is planned as a text book on the first year graduate or senior undergraduate level. Chapters have suggested supplementary readings and lists of problems illustrative of the material under discussion, at least in the earlier portion of the text. In the opinion of the reviewer, there is no other source available which so well explains the development of various viewpoints on the foundations of mathematics. In particular, the discussion of the three present-day "schools of thought," regarding the origin and nature of mathematics: Logisticism, Intuitionism, and Formalism, including the contributions of various men, makes the work outstanding.

While this was probably not the purpose of the author, the book makes an excellent supplementary reference for any course which attempts to treat the history of recent mathematics.

For the purpose in mind, this book is unquestionably an outstanding contribution.

CECIL B. READ

ALGEBRA FOR COLLEGE STUDENTS by Ross R. Middlemiss, *Professor of Mathematics, Washington University.* Cloth. Pages ix+394. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 36, N. Y.

The author in the preface points out that this book differs from his *College Algebra* only in the fact that the first three chapters of that work (11 lessons), have been replaced by five chapters (22 lessons), with the idea of providing a text suited to those students who have had only one year of college algebra. Whether the slower and more detailed review is sufficient is a matter of opinion, the additional material does not seem to offer as much work as is given in some intermediate algebra texts.

College Algebra was reviewed in SCHOOL SCIENCE AND MATHEMATICS in December, 1952 (p. 763); the comments made at that time seem in general applicable to the present text.

CECIL B. READ

COLLEGE ALGEBRA AND PLANE TRIGONOMETRY by James H. Zant, *Oklahoma Agricultural and Mechanical College.* Cloth. Pages x+337+82 (tables). 16×24 cm. 1953. Ginn and Company, Boston, Mass. Price $4.00.

The author feels that a combined course will not only save the student time, but will help him realize the interdependence of various fields of mathematics. Whether there is any great advantage in a single text as contrasted with two courses taught simultaneously is debatable. A few cases, such as solution of cubic and quartic equations involving trigonometric functions, immediately following Horner's method, could be presented by the instructor, even without this type of text.

Certain features of this text are worthy of commendation, for example, the presentation of problems without solutions (as a single illustration from many, series in a set of problems on arithmetic progressions which are not arithmetic progressions); pointing out the fact that a definition is not rigorous, although satisfactory for the purposes of the book; presentation of alternate notations; an exceptionally good treatment of inequalities; an unusual device for determining the complex roots of an equation. On the other hand, this reviewer objected to certain items, some of which may be minor in nature. One of the most serious criticisms would seem to be the lack of an adequate number of exercises to provide for alternate assignments in successive years. In giving the rule for exponents in division it is not specified that the base cannot be zero; alternative definitions for the principal values of the inverse trigonometric functions are not mentioned; the solution of a system of three linear equations by determinants

seems artificial, the mere statement that it is possible to show the method works may not be satisfactory to either teacher or student; on page 123, since the footnote stresses directed line segments, in the next to the last line the student may wonder why sin $B = PN/OP$ and not NP/OP; the definition of the mantissa of a logarithm is not valid unless the decimal part of the logarithm is a positive fraction or zero; on page 156 it is not clear why 0.000025 is rounded to 0.00003 when 0.00002 is equally close; in the set of exercises on mathematical induction some teachers prefer a problem or two in which one or the other of the necessary conditions fails to hold; it is pointed out in working with complex numbers that failure to express $\sqrt{-2}$ in terms of i before carrying out computations will give the wrong result, but there is no reason given; the section on annuities seems too brief to be of much value.

Answers are provided for odd numbered exercises, and are available for even numbered problems; there is a set of tables adequate for the exercises.

CECIL B. READ

AN INTRODUCTION TO MATHEMATICAL THOUGHT by E. R. Stabler, *Department of Mathematics, Hofstra College*, Cloth. Pages xviii+268. 15×22 cm. 1953. Addison-Wesley Publishing Company, Inc., Cambridge 42, Mass. Price $4.50.

The author has as his aim an introduction to the logical structure of mathematics, not a technical treatment either of logic or of the foundations of mathematics. He feels that by proper selection, the book might serve as a text for a brief general education course as a course for prospective secondary mathematics teachers, or as an introductory course for specialists in pure mathematics; moreover, he suggests either a one semester or a two semester course in each case. In the opinion of the reviewer, there is a little too much of "shotgun" attempt at a wide target, rather than writing a text for a particular group. There is wide variation in the mathematical maturity needed to read various chapters—while technically true that only high school algebra and geometry is needed, students with only this background will find some chapters very stiff reading.

This is not a textbook for certain standard courses, rather, the course must be built around the text. If one is teaching a course in which it is desired to introduce the student to the nature of mathematics as it relates to logical thought and the scientific method (and, in the second portion of the text, to gain some introduction to postulational systems and methods) then this text ought by all means to be considered. Even if there is no such course, this book would be a good introductory reference which should be in a college library. It is one which the student can read for himself and go as far, if not farther, into the topic than is the case with the majority of books available. It is doubtful, however, if the average student will get more than a third of the way through the test without some outside help.

CECIL B. READ

THE CHARACTERIZATION OF ORGANIC COMPOUNDS, by Samuel M. McElwain, *Professor of Chemistry, University of Wisconsin*. Cloth. Pages ix+303. 14 × 21 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $4.50.

There is an increasing tendency among college and university departments of chemistry to offer a course in Qualitative Organic Analysis which is usually open to either seniors or graduate students. In the preface of this text, the author calls attention to the fact that some thirty years ago Dr. Samuel P. Mulliken of the Massachusetts Institute of Technology and Dr. Oliver Kamm, formerly a member of the Department of Chemistry of the University of Illinois and now Director of Research at Parke, Davis and Co., were responsible for the early introduction of such a course.

The Characterization of Organic Compounds was adapted to the needs of the students at the University of Wisconsin. However, the first edition of this text (1945) was widely used by colleges and universities as the basis of a course in

qualitative organic analysis. The second edition follows along the same lines of procedure as outlined by the author in chapter one. First, the determination of the physical properties and the establishment of the purity of the compound. Second, determination of the class of compounds (i.e., aldehydes, ketones, acids, amines, etc.) to which the compound belongs. Third, location of the compound within a class. Fourth, preparation of derivatives.

The author states in the preface that the chapter which deals with class reactions has been revised and new procedures added. He also states that the final chapter which deals with the selection and preparation of derivatives has been completely revised. It contains a new section on amino acids and also additional procedures for the preparation of derivatives as well as some timely literature references. Both the theory and laboratory practice are included in this text.The list of sixty-five experiments should give ample practice in the laboratory.

The book is clearly and logically written. The revised edition should have an even wider adoption than the first edition.

GERALD OSBORN
Western Michigan College
Kalamazoo, Michigan

COLLEGE CHEMISTRY, A SYSTEMATIC APPROACH, by Harry H. Sisler of *Ohio State University;* Calvin A. Vanderwerf and Arthur W. Davidson *of the University of Kansas.* Cloth. Pages xii+623. 15 × 22.5 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $5.25.

The authors state in the preface of this text that emphasis will be placed on the "early introduction and continuous application of theoretical principles to descriptive chemistry . . . ." The treatment used is logical throughout. By way of definitions, basic concepts, and familiar phenomena, the student is introduced in turn to the kinetic molecular theory, the atomic theory, and finally the nuclear atom. These are followed by the chemistry of oxygen, hydrogen, and water, chemical equilibrium, and ionic equilibria. The latter half of the book treats the various families of the periodic chart. Three chapters are devoted to the chemistry of carbon and its compounds.

The book is well bound, well illustrated and the type is easily read. A set of appropriate study questions and problems is found at the end of each chapter.

Again we would like to quote a statement in the preface: "The text has been brought up to the minute by inclusion of theoretical and practical developments to January, 1953. We have attempted throughout to give the reader an awareness of the unfinished business of chemistry, which is presented as a series of challenges and problems, some solved, many still in the process of solution." The reviewer feels that this objective could have been supplemented by including some appropriate journal and book references at the end of the chapters. In this way students will be made familiar with some of the chemical literature and will learn how to keep up to date in this ever-expanding field of chemistry.

Teachers of general college chemistry who are considering a change in textbook should give this book their serious consideration.

GERALD OSBORN

QUALITATIVE ANALYSIS AND ANALYTICAL CHEMICAL SEPARATIONS, by Phillip W. West, *Professor of Chemistry;* Maurice M. Vick, *Associate Professor of Chemistry;* and Arthur L. LeRosen, *Late Associate Professor of Chemistry, Louisiana State University.* Cloth. Pages xii+223. 13.5×21 cm. 1953. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $3.75.

This new text should appeal to the teacher who desires an entirely different approach to qualitative analysis. Instead of the classical approach, we have a procedure which completely eliminates the use of hydrogen sulfide.

The cation analysis is divided into seven major groups:

Group I, The Soluble Group (Na^+, K^+, NH_4^+)

Group II, Chloride Groups	(Ag^{+}, $Hg2^{++}$)
Group III, Basic Benzoate Group	(Sn^{++++}, Bi^{+++}, Sb^{+++}, Fe^{+++}, Al^{+++}, Cr^{+++})
Group IV, Fluoride Group	(Pb^{++}, Mg^{++}, Ba^{++}, Sr^{++}, Ca^{++})
Group V, Hydroxide Group	(Mn^{++}, Hg^{++}, Fe^{++}, Cu^{++}, Co^{++}, Ni^{++}, Cd^{++})
Group VI, Amphoteric Group	(Sn^{++}, As^{+++}, Zn^{++})

A few words should be said concerning the basic benzoate group. It will be observed that this group is made up of higher valenced ions. The main principle involved is the fact that the hydroxides containing the most hydroxy groups per molecule possess the smallest solubility products. Thus by proper manipulation of the hydroxy ion concentration, hydroxides or basic compounds of the metals of higher valence (valences of 3 and 4) may be separated from these requiring larger hydroxyl ion concentration for the precipitation of their hydroxides. Therefore, by the regulation of pH (3 to 4 pH value) through buffered solutions and utilizing hydroxyl ions generated through the hydrolysis of a hot benzoate solution, the ions of this group may be precipitated. The group reagents for group III consist of a mixture of ammonium and sodium benzoate.

The text is logically and clearly written and should be easily followed by a beginning student. Among the advantages listed by the authors for this text are:

1. It eliminates the dangers and disagreeable characteristics of hydrogen sulfide, along with hydrogen sulfide corrosion.
2. It provides sharper group separations.
3. It employs standard chemicals and apparatus.
4. It simplifies the teaching of the concepts and calculations of chemical equilibria.

The reviewer feels it does have all of these advantages. The only disadvantage is the fact that many advanced courses in chemistry are built on the assumption that the student is familiar with the classical scheme of analysis, and students having studied a different procedure of analysis, would be handicapped to a certain extent.

GERALD OSBORN

THE ORIGIN OF LIFE AND THE EVOLUTION OF LIVING THINGS, by Olan R. Hydman, M.D. Pages 648. Hallmark-Hubner Press, Inc., Philosophical Library, 15 E. 40th Street, New York. 1952. Price $8.75.

This book presents a new approach and theories for the explaining of the origin and evolution of living things on a physico-chemical basis and as expressions of the operation of the natural law. There are suggestions of certain principles that are felt by the author to govern organic evolution. Many of these appear to be new. An application of one of these principles provides an explanation of the male and female elements, for fertilization and the unexplained events that accompany maturation of the egg and sperm.

The principles as given in relation to the environmental theory form the basis for answering many of our unanswered problems in relation to diseases, for which we have not as yet found an answer. It is the environment that determines the function and operation of the human body. It is felt by the author that what he has given may shed new light on the nature of biological disorders, human behavior and the cause and development of culture.

In the introduction are given three premises to which the author has held throughout the book. These form the basis for the discussion of the environment as the answer to many problems unexplained in the field of biology and life.

Any one interested in life and a detailed discussion of a new approach to the

understanding of the problems of life should be interested in this book. It is not intended for quick and easy reading. It can serve to clarify or fortify the position of the reader in his understanding the place that the environment has in determining basis for life.

NELSON L. LOWRY
Arlington Heights, H.S.
Arlington Heights, Illinois

LIVING THINGS, by Frederick L. Fitzpatrick, *Head of the Department of Teaching of Natural Sciences, Teachers College, Columbia University;* and Thomas D. Bain, *Harding High School, Marion, Ohio.* Cloth. Pages xiv+415. 17.5×25 cm. 1953. Henry Holt and Company, Inc., New York. Price $3.60.

This is a new biology text which, according to the authors, is built about meaningful material—that which relates to the needs and interests of the students in their meeting of everyday problems. It contains eight units: Biology Concerns Your Everyday Life, This World in Which You Live, Life in the Plant World, Life in the Animal World, Your Body and How It Works, Most Diseases Can Be Controlled, All Living Things Reproduce, and Conserving Our Resources. These are divided into "topics" and then further, into chapters. At the end of each chapter there are short-answer items and a definition of scientific terms used for the first time. Each topic division is concluded similarly with summary questions, suggestions, etc.—as are the units. The type is large and readable, the illustrations numerous and clear. It's a new book with a refreshing format and style of presentation, a delightful departure, certainly, from the old standards among biology texts.

GEORGE S. FICHTER
Oxford, Ohio

BUILDING HEALTH, by Dorothea M. Williams, *Cole Junior High School, Denver, Colorado.* Cloth. Pages xi+431. 16×22 cm. 1952. J. B. Lippincott Company, New York.

Building Health is a junior high school classroom text on health instruction, based upon results of a study made in Denver to learn the interests which show high during adolescence. *Doing*, as in so many texts nowadays, is the emphasis, with numerous exercises for individual and class projects. Too, the text is organized in such a manner that it need not be used chronologically but can be resorted to as a source of information.

Each chapter is prefaced by a "Picture Preview" designed to stimulate the students' interest. Each chapter, too, is prefaced with suggestions for individual and committee experiences, panels, research, and various activities at home and in the community. Each chapter is concluded with a series of test materials covering the health concepts developed within the chapter. There are listings of other references, films, etc. to be used as aids.

The author made special effort throughout the text to challenge the student. Subheadings are in the form of questions, as are captions for the numerous illustrations. And the text itself continually arouses the student's curiosity. All in all, this would seem to be a most worthy book for consideration.

GEORGE S. FICHTER

ENJOYING HEALTH, by Evelyn G. Jones, *Special Teacher Department of Instruction, Denver Public Schools.* Pages xi+434. 16×22 cm. 1952. J. B. Lippincott Company, New York.

Enjoying Health, a senior high school text, is a companion value for *Building Health;* it is similar in design and treatment, differing only in its level of approach.

GEORGE S. FICHTER

PHYSICAL CHEMISTRY, Third Edition, by Frank H. MacDougall, *Professor Emeritus of Physical Chemistry, University of Minnesota.* 750 Pages. 13.5×21.5

cm. 1952. The Macmillan Company, 60 Fifth Avenue, New York 11, N. Y. Price $6.00.

The third edition of this well known text is not greatly altered except for extensive revision in the chapters on atomic structure and reaction kinetics. In both chapters the material added is of a complex nature which probably would be difficult for the average student of physical chemistry to comprehend. However, its inclusion is justified if some students gain something of value from it.

The book is well organized and presents the essential material of physical chemistry in a logical fashion. The historical background accompanying various topics is particularly well done and adds to the interest in the subject with which it is connected. The introduction of electromotive force by use of Coulomb's law is an approach not usually used in physical chemistry text books and is effective. Some might question the advisability of an arrangement which includes a chapter on energy and the first law of thermodynamics before the one on gases. However, it makes the heat capacity of gases more understandable.

Distillation of liquid mixtures is included in the phase rule portion of the heterogeneous equilibrium chapter rather than with solutions, as is the case in most physical chemistry texts. This is desirable as it serves to emphasize the wide range of systems included under the phase rule.

Problems are not very numerous since the author suggests in the preface that the place for meaty problems is in the exam. This is a good idea, but most students need some hard problems to prepare themselves for those on the exam. The inclusion of the solution of more sample problems seems desirable as this is a most effective means of acquainting students with methods of problem solving.

In introducing two component phase rule systems involving liquid and solid, thermal analysis is not mentioned but is left until the end of the section before it is presented. If the cooling curves derived from thermal analysis are shown first, the phase rule diagrams are more easily comprehended.

At the present time when ammonia and numerous other commercially important substances are synthesized from gases under pressure it would seem desirable to mention, in the gas chapter, such devices as compressibility factor and the Hougen and Watson chart which have proved so useful in calculating PV relations under non-ideal conditions.

The laboratory applications of physical chemistry are covered very briefly if at all. For instance, no mention of the spectrophotometer or similar instruments is made in connection with the presentation of Lambert's and Beer's laws. While the inclusion of the description of physical chemistry apparatus and its use can easily be overdone, it seems desirable to keep before the student the fact that the principles he studies are not theoretical but can be substantiated in the laboratory.

MacDougall's text contains adequate material for a thorough course in physical chemistry. The criticisms included in the review are not of major importance, and thus the reviewer feels this textbook is worthy of inclusion with the other excellent offerings of the publishers in the field of physical chemistry.

LAWRENCE G. KNOWLTON
Western Michigan College
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ELEMENTARY ANALYSIS, by Kenneth O. May, *Chairman of the Department of Mathematics, Carleton College.* Pages xviii+635. 14×21 cm. 1952. John Wiley and Sons, New York 16, N. Y. Price $5.00.

This book treats the material usually covered in algebra, trigonometry, analytic geometry, and introductory calculus. The minimum background of the student should include one year of high school algebra and one of plane geometry.

One of the author's stated purposes in writing this book is to introduce greater

vigor in presenting the material than is usually attempted. In the second chapter a discussion is given as to the meaning of a "proof" and the distinction is made between necessary and sufficient conditions. The concepts of set and variable are introduced. The third chapter gives the development of the number system. Operations with the integers are defined and the commutative, associative, and distributive laws are presented in much the same manner as in a modern algebra text. The author is quite consistent in referring to these laws throughout the text. From the integers the zero, the negative integers, and the rationale a developed rigorously. No attempt is made to develop the irrationals rigorously.

To unify the course the author studies the various topics in relation to the type of function involved. For example in Chapter 4 under linear functions one studies arithmetic progressions, analytic geometry of the straight line, translation of axes, and solution of linear equations using determinants. The concept of a function as a correspondence between two sets is introduced. The derivative is introduced in Chapter 5 in connection with the quadratic function and the distinction between the average rate of change and derivative of a function is presented well. In Chapter 6 the principle of finite induction is introduced and used in proving some of the laws of exponents. The use of induction proofs is emphasized throughout the book. Permutations and combinations, the binomial theorem geometric progressions, inverse functions, and rational exponents are introduced in the chapter on power functions.

The exponential and logarithmic functions, the circular functions, the polynomials, the algebraic functions, and the function of two variables are other chapters in the text. Integration is treated briefly in the chapter on polynomial functions.

The book contains approximately 6800 problems which vary in difficulty. There are problems to challenge the best student yet enough of average difficulty. Many applied problems are found from all branches of science. Answers to some of the problems are given with the problems and seem to be sufficient in number.

In several instances the author deviates from the usual presentation of material. In the study of circular functions all of the analytic trigonometry is presented first and the trigonometry of the right triangle and the solution of triangles is presented last. The conic sections are presented first as special cases of the general equation of second degree in x and y and later as loci.

This book should appeal to the above average student with an interest in mathematics. The wealth of problem material available will require careful teacher selection. The reviewer feels that an inexperienced teacher with an average class would have some difficulty using the book.

HAROL V. HUNEKE
University of Wichita
Wichita, Kansas

EUROPE, Second Edition, by Samuel Van Valkenburg, *Clark University*, and Colbert C. Held, *University of Nebraska*. Cloth. Pages xiv+826. 14.5×23 cm. 1952. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $7.50.

Since the publication of the First Edition of *Europe* in 1935, Dr. Ellsworth Huntington, its co-author, has died. His place in the preparation of the Second Edition has been taken by Dr. Held.

The new volume follows the general plan of organization of the First Edition, but the presentation of several countries has been entirely rewritten, and that of others greatly expanded. All have been brought up to date.

The first fourteen chapters present an over all picture of Europe, its climates, soils, land forms, vegetation, minerals etc.; its manufacturing, trade, transportation, people and political units, problems of population distribution etc. The remaining thirty-two chapters deal with the countries of Europe. The economic, cultural and political problems of each are interpreted in terms of geographical settings.

The volume is well supplied with excellent maps and half tone illustrations. The Appendix furnishes data concerning countries,—area, population, cities, etc., and a comprehensive Bibliography.

While *Europe* is a text intended for college and university classes, it should appeal to the general reader interested in current world affairs and in need of an understanding of Europe at this midpoint in the twentieth century.

VILLA B. SMITH
John Hay High School
Cleveland, Ohio

THE GEOGRAPHY OF EUROPE, Second Edition, by George D. Hubbard, *Professor Emeritus, Oberlin College, Oberlin, Ohio.* Cloth. Pages xvii+870. 15×23 cm. 1952. Appleton-Century-Crofts, Inc., 35 West 32d Street, New York 1, N. Y. Price $6.75.

This Second Edition presents the Europe that emerged from World War II with its new alignments of people and its changed boundaries. It records these changes on the unchanging stage furnished by geology and physiography, and conditioned by factors of climate. It follows the general plan of the First Edition published in 1937. Careful revisions and additions, many new half-tone illustrations and new maps bring the volume to date.

VILLA B. SMITH

IT'S FUN TO KNOW WHY, EXPERIMENTS WITH THINGS AROUND US, by Julius Schwartz, illustrated by Edwin Herron. Cloth. Pages 125. 14×20 cm. 1952. Whittlesey House, McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y.

This is a book for the elementary science people written by a man who has had many years experience as a teacher of science. In it he tells many of the interesting facts about some things you depend upon daily, and shows how to perform experiments that give more information. His important topics are iron, coal, cement, glass, rubber, wool, salt, bread, soap, and paper. Plenty to talk about, much to learn, every bit interesting.

G. W. W.

MAN, THE PHYSICAL EARTH, AND THE WORKS OF MAN

Man himself is just as important in the study of geography as his environment and his culture, Prof. Glenn Trewartha of the University of Wisconsin reminded fellow geographers at Cleveland, April 1.

Prof. Trewartha, who is president of the Association of American Geographers and an international authority on populations, stated the "Case for Population Geography" in his presidential address during the annual banquet of the association.

"The only final value is human life or human living, and, this being the case, it is difficult to understand why geographers should judge the creations of man, and the environment out of which he creates them, to be relatively more important than man himself," he said.

Because geographers have for the most part classified all earth phenomena as either physical or cultural, the human animal, which fits logically into neither category, has been considered something of an outsider and misfit, he continued.

"For this reason I propose a basic modification in the structural outline of content for geography in order to give population a more explicit position and one which its importance rightfully warrants," he said. "I propose a three-fold organization of the elements in which man, the physical earth, and the works of man are the triad of elemental groupings within a unitary geography.

"At the risk of stating the commonplace, it may be noted that the cultural features which embellish the earth's surface in almost limitless combinations as developed through time are the evidence of successive periods of human occupance," he continued.

"From culture may be read the chronicle of population, its ebb and flow, its accomplishments and defeats; for culture accurately reflects the numbers, and even more precisely the qualities, of its creators. Man, the creature unlike all others, who has emancipated himself from passive adaptation and natural selection, is the one animal that is able to change the environment to fit his needs.

"To be sure, the resource base is still the foundation of human enterprise even in the most advanced civilizations, but to an ever-increasing extent the resources of civilized man are not natural resources but human inventiveness, experience, and knowledge.

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